Spring 1-1-2011

Food Habits and Physical Activity Patterns Among Children Living in the San Luis Valley, Colorado

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FOOD HABITS AND PHYSICAL ACTIVITY PATTERNS AMONG CHILDREN LIVING IN THE SAN LUIS VALLEY, COLORADO

by

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A thesis submitted to the

Faculty of the Graduate School of the

University of Colorado in partial fulfillment

of the requirement for the degree of

Doctor of Philosophy

Department of Anthropology

2011

This thesis entitled:
Food Habits and Physical Activity Patterns among Children Living in the San Luis Valley, Colorado
written by Heather Susan Williams
has been approved for the Department Anthropology

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The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

IRB protocol # _Colorado Multiple Institutional Review Board #06-1153

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Thesis directed by Professor Darna L. Dufour

The relatively recent increase in obesity among children in the United States has become of interest to researchers. In the past 10 to 15 years, research has typically focused on "at risk" populations, health outcomes and potential causes of obesity. As a result, the prevalence, associated disease risks, and potential causes of obesity have been well documented. Poor diet quality, high energy intake (primarily from sweetened beverages and fast food) and low physical activity levels have all been linked childhood obesity. Despite this large body of literature, few studies have focused on the biocultural aspects of childhood obesity, especially among children living in rural parts of the western United States. This study took a biocultural approach to childhood obesity in The San Luis Valley; a low income, rural region in south-central Colorado, with a high prevalence of obesity and chronic disease (e.g. type II diabetes). While there have been epidemiological studies in the Valley, until recently, the majority have focused on adults. This study used both qualitative (observations and interviews) and quantitative data (anthropometry, dietary intake and physical activity monitor data) to examine the role of household, community and school environments in developing dietary and physical activity patterns among elementary school children (7-12 years of age) in the Valley. The percentage of overweight/obese children in the study sample was higher than the state average. There was no association between being overweight or obese and diet, but there was between being overweight or obese and low physical activity levels. Some results were similar to studies in other parts of the United States, while results were not. Finally, this study highlighted the importance of both qualitative and quantitative data in understanding the local social, cultural and environmental contexts within which obesity develops among some populations.

This dissertation is dedicated to Kenneth and Juliet Williams –
For all of your sacrifices, and the love and support that got me here.
You truly are the best parents a kid could ask for.

AKNOWLEDGEMENTS

In my years as a graduate student at the University of Colorado, I have been fortunate enough to have had been guided and mentored by the exceptional faculty of the Anthropology Department. I am honored and proud to say that I was once a student in this department. When I think about how and why I became interested in anthropology, I must take a step back and think about those who first sparked my interests in the field. My interest in anthropology began my senior year in high school, when I chose to take an anthropology course to fulfill my last social science requirement. I will never forget the first day of class when Mr. Wilkie showed slides of his recent trip to Africa, where he had helped with a hominin fossil excavation. The following week, we had to collect our trash for a week, and after the collection, the class conducted an archeological investigation on the trash bags to learn more about each other's daily habits. This was only the beginning; there were more projects, and readings in which we learned more about paleoanthropology, archaeology and cultural anthropology. By the end of the class I was inspired by anthropology, and in my second year of college, began taking courses in anthropology. During this time, I had the opportunity to work with a wonderful undergraduate advisor, Dr. Jonathan Kent, who taught me about field archaeology, and gave me the opportunity to conduct archaeological fieldwork in Colorado and Peru

Since this introduction to anthropology, I have continued to be inspired, and will always look for new ways to ask questions about humans, our biology, our evolutionary history, and our relationship with the natural world. I owe my continued love for the field to years of mentoring from anthropologists and faculty that I have been lucky to have met and worked throughout my graduate studies. First, and foremost, I would like to thank Dr. Darna Dufour, who has been a wonderful advisor, mentor and friend. Thank you for giving me the opportunity to explore my interests in nutritional anthropology and human biology, the many conversations about diets, anthropometry, research, writing, and teaching. Thank you for giving me the opportunity to be a part of the work efficiency study; I would have never discovered how much I loved conducting research in human biology had I not worked on this project. Thank you for helping me to think about the design of my dissertation project. Thank you for reading and providing invaluable feedback on the many drafts of my grant applications, abstracts, posters, papers and chapters of my dissertation. Most of all, thank you for always keeping me on track, helping me find my way when I am lost, and reminding me that each project is not the end, but rather, it is only the next step, or the continuation of my life in anthropology. I hope that someday, I can be the wise, understanding and supportive advisor and mentor that you have been to me.

I am enormously grateful to Drs. Herbert Covert, Michelle Sauther and J. Terrence McCabe. Thank you for sitting on my committee, your guidance, wonderful seminars and courses, and helpful comments on my dissertation. I must also thank the faculty who have mentored me and guided me through coursework and research not directly related to my dissertation. I would also like to thank Dr. Linda Cordell, who gave me the opportunity to conduct research in New Mexico and learn more about Southwest archaeology. To everyone, I feel honored and fortunate to have been one of your students. I would also like to thank Ms. Valerie McBride, Ms. Karen Lund, and Ms. Lesa Morris for all of the administrative and moral support in my years as a graduate student.

In addition to the years of guidance from the faculty in my department, I am grateful to the others that made the research and data analysis for this dissertation possible. First, I would like to thank Dr. Julie Marshall, without her, this project would have never have come to life. Thank you for giving me the opportunity to work with the Rocky Mountain Prevention Research

Center (RMPRC), allowing me to integrate my project into the San Luis Valley Healthy Family Project, inviting me to help with other projects in the Valley, sitting on my thesis committee, reading my drafts, and most of all, thank you for introducing me to all of the wonderful researchers and staff at the RMPRC. I would also like to Dr. Elaine Belansky for allowing me to help with the School Environment Project as well as the Integrated Nutrition and Physical Activity Program. My participation in these projects was essential to research for this project. Many thanks to Mr. Robert Chavez and Ms. Rose Martinez for first, their enormous help in facilitating my participation in other Prevention Research Center Projects, steering committee meetings, school visits, data access; and second, welcoming me to Alamosa and making me feel like part of the RMPRC family. Thank you to Ms. Liza Marron for getting me involved in the "Live Well" Colorado projects in Alamosa. Many thanks to Ms. Sharon Scarbro for her enormous help with the dietary and accelerometer data. Thank you to Allison Reeds for all of her administrative support during my stay in Alamosa.

I owe an enormous thank you to the families and elementary schools of the San Luis Valley who participated in the observations, interviews, and clinic visits which made this project possible. I will always consider the Valley to be my second family and home, and I owe this to all of the wonderful people and families that I met during my residence there. Thank you to the families that so graciously and generously invited me into their home and allowed me to follow them around all day; the school principals, teachers and food service staff who allowed me to visit their schools and patiently answered my questions. I would also like to thank the many other community members who would always would remember me, and take a moment to say hi and visit with me, even though we had just met, or had only met in passing at the grocery store. I could not have completed this project without your participation and help. I would also like to say a special thank you to Brad and Billie Rue, Mick Daniel, Patrick Connelly, and Lynn and Shirley McCullough, Kathy Alejo, Kathy Trujillo, Sharon Windhorst, and the members of the San Luis Valley Cycling Club. Thank you for your continued friendship, inviting me to join you in the many community events in which I was able to participate, and showing me the natural beauty of the Valley.

This project would not have been possible without the financial support from the: University of Colorado, Boulder, Department of Anthropology; University of Colorado, Boulder, Graduate School; National Institutes of Health/National Institute of Diabetes and Digestive and Kidney Diseases; and University of Colorado, Denver, Colorado School of Public Health and Rocky Mountain Prevention Research Center.

I would like to thank my all of my friends and family who have stood by me, and supported me through the years. I am ever so grateful to Mr. James Ishman; thank you for your many, many years of friendship, support and encouragement, you really are a brother to me. I would also like to thank Mr. Douglas Hiebert for his years of support and encouragement; Dr. Krista Fish for her support and many conversations about writing and teaching over lunch; and my fellow graduate students for their friendship and support. Finally, I owe a very special thank you to Mr. James Millette, my fellow graduate student, best friend, companion and partner in crime. Thank you for always being there for me, especially when I need you the most. Thank you for listening to my ideas, sharing your love for the outdoors with me, working with me on various projects, teaching me about ring-tailed lemur teeth, and of course, first giving me the idea to measure plate waste on school lunch trays. You truly are my other half, and without you I would be incomplete.

Lastly, but certainly not least, I want to thank my parents, Kenneth and Juliet Williams, to whom I have dedicated this dissertation. Since I was born, you have encouraged me, made sacrifices, and given me support (both morally and financially) so that I could fulfill my dreams or crazy ideas. From staying up all night to support me at a 24-hour mountain bike race, to making sure that I could devote my time to my education and research, my parents have always been there for me. Thank you for teaching me to follow my dreams, do what I love, and live life to the fullest. I would not be the person I am today, nor would have gotten this far without you guys. Thank you mom and dad, you are the best parents ever.

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CHAPTER I:

INDTROCUTION

Obesity and health outcomes among children in the United States

It has been argued that a key adaptive feature of human life history, much like many other mammals, is the increased ability to accumulate and store fat. The argument has been that this ability evolved in humans to accommodate energy shortages during seasonal fluctuations in food supply, provide a buffer for pregnancy and lactation and support increased energy requirements for brain growth during infancy (Wells 2005; Kuzawa 1998; Norgan 1997; Ulijaszek and Lafink 2006). With industrialization and more recently, a global food supply, extreme seasonal fluctuations in food supply have decreased. Likewise, we have become less physically active than in our evolutionary past, reducing our daily energy requirements. However, our ability to store fat has remained, and with the globalization of food, energy intakes have remained high, resulting in a worldwide nutrition transition and rapid increases in obesity. It has been argued that this nutrition transition and rapid increase in obesity reflect a mismatch between our evolutionary heritage and an obesogenic environment (Ulijaszek and Lafink 2006).

Within the United States, this mismatch has become increasingly apparent among children over the past two decades. For example, data from the 1999-2002 National Health and Nutrition Examination survey (NHANES) used BMI (Body Mass Index, kg/m^2) age and gender specific growth percentiles from the Centers for Disease Control and Prevention (Kuczmarski et al. 2000) to assess weight status. The results suggested a fourfold increase in childhood overweight and obesity (BMI above the 85th percentile) between the seventies and nineties. At the time of the survey, 31% of the children between the ages of 6 and 11 years who were measured, had a BMI (Body Mass Index) above the 85th percentile, and could be classified as being overweight, and 19.8% had a BMI above the 95th percentile, and could be classified as obese. Whereas in the seventies, about 5% of the children measured were overweight or obese (Hedley et al. 2004; Flegal et al. 2004). More recent data from the 2007-2008 National Health and Nutrition Examination Survey (NHANES) indicate that the trend has not reversed for 6 to 11 year old children. Over half of the children measured were overweight or obese; 35% percent of the children had a BMI above the 85th percentile, 19.6% had a BMI above the 95th percentile, and 14.5% had a BMI above 97th percentile. Among Hispanic children measured, the percentages of children above the 85th, 95th and 97th percentiles were higher (42.6%, 25.1% 19.3% respectively) (Ogden et al. 2010).

Some have argued that the increased prevalence of childhood obesity also has implications for increased health risks among children. Studies by Braunschweig et al. (2005), Goran et al. (2003), and Sorof et al. (2004), have all suggested links between increased body weight and health risk, and have identified insulin resistance and hypertension among groups of overweight children between 8 and 13 years of age. The results of these studies are striking because the diseases that have been identified are typically chronic health problems associated with adults and aging, yet they are occurring in children at such a young age. Also interesting is that the highest rates of disease in these studies were among children from, low income Hispanic and African American communities.

Although obesity and chronic disease have been well documented among children in the United States, and some contributing factors (e.g. diet, physical activity levels) have been identified; the biocultural contexts in which these factors influence obesity have been less studied and are still not well understood, especially at more local level. Furthermore, the majority of childhood obesity studies have been large scale surveys, conducted in larger urban areas in the United States. However, a small number of studies conducted in rural areas suggest that rural communities are also at risk for obesity and obesity related health problems (McMurray et al. 1999; Jackson et al. 2005; Patterson et al. 2004). As such, there are likely factors specific to rural living that may be contributing to the observed increases in obesity; these factors may be very different than those which have been identified for urban communities. Moreover, the small number of studies that have been conducted in rural areas, focused primarily on areas the eastern and southeastern United States (McMurray et al. 1999; Crooks 2000; Treuth et al. 2005; Eichner et al. 2008). However, there are rural areas in the western United States that also have higher obesity rates compared to urban areas. For example, between 2005 and 2006, the percentage of overweight and obese children living rural Colorado was 7% higher than children living in urban areas in the state (Colorado Department of Public Health and Environment 2006).

While the prevalence of obesity among rural children in Colorado has been identified, the relationship between socio-cultural, economic and political factors and obesity in these areas is still not well understood. The purpose of this study is to examine the dietary and physical activity patterns among elementary school children living in south-central, rural Colorado, as well as examine some potential factors within the community, household and school environments which may impact energy balance and lead to obesity among these children.

Previous research in the United States and Europe has examined a number of different variables within the community, household and school and their association with diet and physical activity. For example, patterns in restaurant use and school policy have been examined in relation to children's dietary patterns (Bowman et al. 2004; Briefel et al. 2009; Clark et al. 2009). Similarly, the association between parental physical activity behaviors and their children's physical activity levels has been studied among families in England (Jago et al. 2010). These kinds of relationships are not well understood among children in the Valley. The purpose of the current study is to examine some of these variables and their impact on weight status among elementary school aged children in the Valley. Below is a brief discussion of the sample of children who participated in the present study, as well as a summary of some of the previously studied variables that have been linked to childhood obesity. During the course of the present study, some of these variables were considered in order to better understand food habits and physical activity patterns and their impact on children in the San Luis Valley, Colorado.

The San Luis Valley Healthy Family Project Design and Participants

The quantitative data in the present study were from a sample of children who were part of a larger study being conducted in the Valley; the San Luis Valley Healthy Family Project. The Healthy Family Project was a 12-month randomized control study designed to test the effectiveness of home-based lifestyle coaching on dietary intake, physical activity patterns and weight status among families at risk for type 2 diabetes. The goal was to help families: 1) increase their fruit, vegetable and whole grain intake to the recommended number of servings (3-5 servings/day); 2) decrease total fat and saturated fat intake (less than 30% and 10% respectively) each day; 3) increase physical activity to 30-60 minutes of moderate activity on most days; and maintain a healthy weight or achieve a 7% weight loss (Rocky Mountain Prevention Research Center 2007).

All families participating in the Healthy Family project were scheduled for 3 clinic visits (baseline, 6-months, and 12-months) over the 12 month period. Each visit included a series of anthropometric measurements (height, weight, waist circumference and blood pressure), and an interview which included questions about diet, physical activity, health care, and community resource use. At the baseline and 12-month follow up interviews, each participating family member completed a 24-hour dietary recall and was fitted with an accelerometer to be worn for seven days following the clinic visit. In addition, children between 7 and 18 years of age were asked to return to the clinic a week after their baseline and 12-month visits to complete second 24-hour dietary recall.

Two thirds of the participating families were randomized into an experimental group, which participated in 12-16 home visits with a lifestyle coach in addition to the clinic visits. During the home visits, the coach worked with families to set goals for improving diet and physical activity and included specific “Hands-on” activities designed to meet the family’s goals. Some of activities included a label reading exercise at the grocery store, cooking lessons, games and hikes.

A total of 246 families participated in the study; 38 of these families had children between 7 and 11 years of age at the baseline clinic visit. Children who were between 7 and 12 years of age at their 12 month visit for the Healthy Family Project were also invited to participate in a supplemental observational study which included having a researcher observe their daily activities and dietary intake. Five children and their parents agreed to participate in the supplemental study. Written informed consent was signed by at least one parent, and assent forms were signed by all participating children. All research was approved by Colorado Multiple Institution Research Board.

The San Luis Valley Healthy Family Project and supplemental observational study not only provided insight into the effectiveness of home-based coaching on families in the Valley, it also opened up a unique opportunity to live in the community, spend time with local families and visit many of the schools in order to gain a better understanding of life in rural Colorado. Because the study involved families from different towns all over the Valley, there was some variation in family size, income, town size and school districts between families. This provided the added benefit of being able to look at many different aspects of rural life that may not be apparent by studying families from a single town. Finally, the present study was developed in order to provide contextual information about these families and the schools to perhaps inform future studies and decisions regarding policy changes in the Valley. This study also compared dietary habits and physical activity patterns of the children in the Valley to the dietary habits and physical activity patterns of other children of similar age in the United States in order to better understand the impact of rural living on health outcomes among children.

Food access, food consumption and their contribution to food habits

The first part of this study examined energy intake and dietary patterns among children. Previous studies have suggested (Crooks 2000; Adair and Popkin 2005; Grund et al. 2001) a link between excessive energy intake and overweight among children. Furthermore, there have been documented changes in eating trends which are associated with national increases in overweight in the past 20 to 30 years, especially between 1977 and 1996. In a comparison between dietary surveys collected in 1978 and 1996, Nielsen et al. (2002), found that children and adolescents increased their energy intake and the proportion of total energy coming from snacks (240 to 409 kilocalories per day). Data from the same surveys also indicate a shift towards an increased number of meals consumed at restaurants. Between 1978 and 1996, the number of restaurant and fast-food meals increased from 4.7% to 16.7% of total meals (Nielsen et al. 2002). In addition to a shift towards more restaurant meals, the survey indicated an increased consumption of specific foods at restaurants. Between 1978 and 1996, there was an increase in the percentage of pizza (1.4% to 3.9%), french fries (1.9% to 3.0%) and cheeseburgers (0.3% to 1.5%) consumed at restaurants or fast-food establishments. Similarly, results from the Bogalusa Heart Study (Nicklas et al. 2004) indicate an increase in sweetened beverage consumption between 1973 and 1994 (370 grams per day to 448 grams per day respectively). The trends reported in these surveys have been associated with a secular increase in body weight, and suggest a causal relationship between dietary changes and national increases in childhood obesity. However, these studies present data from large surveys and do not explain regional and ethnic variation in food choices or habits that may lead to overconsumption of particular foods.

In an attempt to address regional variation in food consumption, Chapters 3 and 4 examine food habits and food and beverage choices among children in the Valley. In Chapter 3, total energy intake and diet composition are compared to recommended energy requirements for children of similar age, weight and physical activity levels (Institute of Medicine 2005). In order to identify any local patterns in dietary intake, the results are compared to energy intake reported for other children in the United States. Chapter 3 also assesses diet quality of the children using the Healthy Eating Index-2005 (HEI-2005), and compares these results to other children in the United States. Chapter 4 continues to examine diet quality and dietary patterns. Specifically, the chapter focuses on patterns in beverage consumption and restaurant use. Both chapters examine the relationship between dietary intake, diet quality and weight status, as well as how the results compare to larger national samples of children in the United States.

Another less understood, but interesting aspect of food consumption, especially in regard to the disproportionate increases in obesity among low income ethnic groups, is the impact of food access and food insufficiency on food consumption. Studies (Casey et al. 2005; Kaiser and

Townsend 2005) have found families from lower income households tend to have limited access to healthy foods (fruits, vegetables, whole grains and lean meats) and suffer periodic food shortages in the households. In a survey by Casey et al. (2005), low income Hispanic families reported a lower quality diet (high fat, low fiber) and more periodic food shortages than other families in the survey. These shortages occurred most commonly at the end of the month, or close to the end of the pay period. On a larger scale, Morland et al. (2002) found that low income neighborhoods had more fast food type restaurants, fewer large chain grocery stores, and less transportation access to large stores than higher income neighborhoods. As a result, residents in low income neighborhoods had to rely on small corner stores that sold highly processed lower quality foods, fewer fresh fruits, vegetables, and lean meats. Although the Morland et al. (2002) study focused only on adults, their access to food can influence the diet of children in the same household. One way children's dietary habits could be affected by their parents' limited access to grocery stores is by limiting household access to healthful foods, such as lean meats, fresh fruits and vegetables and whole grain. Jyoti et al. (2005) have reported higher BMIs (Body Mass Index = weight kg/height (m^2)) in children from low income households with periodic food shortages, and suggest that these shortages lead to overeating during times when foods are available. Jyoti et al. (2005) suggest that this "feast and famine" pattern of eating may lead to weight gain over time. What Jyoti et al. (2005) did not report, and it has not been well studied, is where this overeating occurs (i.e. at home, within the community through meal networks, or at school through federal meal programs). The present study examines the potential food resources within the local community (community resources and access to food stores), household (social food networks and household income) and school (school lunch program use) resources. Because the study focused on a low-income community, household income was considered and compared to food consumption patterns.

Finally, the food environment, whether at school, home or within the community likely has a strong impact on children's dietary habits, and therefore likely influences weight. Previous studies (Kandiah and Jones 2005; Hendy et al. 2000) suggest that eating patterns are formed by age 12, and school based interventions designed to promote "healthful" eating through increased fruit and vegetables and decreased fat intake are most effective when implemented between the ages of 8 and 12 years (Hendy et al 2000; Kandiah and Jones 2005). Recently, Belansky et al. (2006) also reported on the success of a school based nutrition education program in increasing knowledge, attitudes and self-efficacy with regard to nutrition among elementary school children in rural Colorado. Despite the success of these school based programs, there are likely other variables within the community, home and school nutrition environment that could potentially influence dietary patterns outside of the school cafeteria. Some of these factors include: cultural ideals about food and parental influence on dietary intake (i.e. allows free access to foods or serves children, views of ideal body image), household characteristics, variety of foods available (at school and outside of school), distances between the household and restaurants and family access to transportation. In assessing energy intake and dietary patterns among the children in this study, all of these variables were considered. In Chapters 3 and 4, observations and information provided by adults and children through formal and informal interviews are compared to the data analyses. The impact of cultural ideals about foods, food variety, and family access on dietary intake are discussed.

Physical activity among children

The second part of this study examined the association between weight status and physical activity. In addition to excessive energy intake, low activity levels have been cited as a major contributor to overweight among children, and previous studies have reported an association between the two (Butte 2007; Treuth et al. 2004). There are likely a number of factors within the community itself that could potentially impact a child's daily physical activity patterns. Many of these factors may either work as a barrier to physical activity, or promote physical activity.

Potentially important variables that may facilitate or hinder physical activity levels may include: perception of neighborhood safety, community layout and design (i.e. access to parks, sports fields, trails and community centers; sidewalks and busy streets) community resources for activity programs, and cost of organized programs. Distance between the household and schools or parks may also play a role. Families that live closer to schools and parks are likely to have children who walk to school, and use the park more frequently than children who live farther from schools and parks.

Similarly, there are a number of factors within the household and school environment that may affect daily physical activity patterns and levels. For example, household characteristics may influence physical activity. Perhaps households with two working parents, or a single parent with a full-time job do not have time for extra activities (pee-wee sports, taking the kids to the park etc.). There may be low income households which do not have the financial means to enroll children in afterschool activities, or families may have limited access to a vehicle which in turn, would limit children's access to out of school sports and activities. Parents and family members may also facilitate physical activity though modeling (running, biking, joining a gym), and encouraging (taking them to practice, volunteering as a coach, setting aside time to go to the park etc.) their kids to be active.

Finally, the school environment may play a role in physical activity through policy and the built environment. School policies on minutes of physical education each week and number and minutes of recesses, as well availability of PE and playground equipment may work to promote (having adequate PE classes and recess) or discourage (cutting PE classes, eliminating recesses, having unappealing playground equipment) daily physical activity levels. Furthermore, staff may model physical activity patterns. For example, a PE teacher, principal or classroom teacher may promote physical activity by encouraging students, or participating in activities themselves (e.g. running, skiing biking, coaching). All of these school factors may have an important role among low-income children whose only access to physical activity programs is through the school. While this study does not specifically focus on the school environment, it is considered in the physical activity analyses.

Chapters 5, 6, and 7 focus on physical activity. In Chapter 5, daily physical activity levels (e.g. total activity and time spent in moderate-vigorous activity levels) and their association with overweight are examined. The results are compared to data reported for other children in the United States. In addition, Chapter 5 utilizes direct observations made within the household environment to provide context for the physical activity levels observed in the analyses of accelerometer data. Likewise, the potential influence of school participation in an intervention study aimed to increase physical activity at school on physical activity levels is also discussed in chapter 5. In Chapter 6, changes in physical activity levels that may have occurred between the baseline and 12-month measurements are assessed. Finally, in Chapter 7 the relationship between parent and child physical activity levels is examined. Again, characteristics of the household and community environment are considered as potential variables influencing children's physical activity. In all three chapters, both household income and seasonality (in school or out of school) are also considered as potential variables influencing physical activity levels.

Food habits and physical activity within the context of a larger intervention study.

The San Luis Valley is a low-income rural community in Colorado, with a Hispanic population at high risk for obesity and type II diabetes. There has been a relatively long history of research in the Valley, and currently, the focus is on research designed to help at risk families prevent or delay the onset of chronic disease through a number of lifestyle changes. The San Luis Valley Healthy Family Project was one of these projects. The intervention included adults, children (over 7 years of age) and adolescents living in the household, which provided a unique opportunity to examine household characteristics in relation to children's energy balance. The intervention study itself focused primarily on making changes within the household, and did not target the school or community environment. As a supplement, this study incorporated aspects of the school and community in addition to household characteristics to determine their impact on diet and physical activity patterns among children participating in the San Luis Valley Healthy Family Project. The observations conducted throughout the course the study, provided additional context for other dietary and physical activity data (i.e. dietary recalls and accelerometers) collected through the Healthy Family Project. Chapter 8 discusses the results of the dietary and physical activity analyses from all of chapters together and provides some final conclusions about their relationship to weight status among the children in the study, as well as in the San Luis Valley. Some of the limitations and directions for future research are also discussed in Chapter 8.

Food Habits and Physical Activity, beyond the San Luis Healthy Family Project.

Although this study was designed in part as a supplemental study to a larger intervention study, it was also independent of the Healthy Family Project, in that included a large qualitative component that went beyond the larger intervention study. A large part of this component came from being a Valley resident and participation in daily community life. This type of participation resulted in informal observations and conversations with community members, usually while frequenting local businesses and open space, or through participation in community events either as a participant or volunteer (e.g. Walk to School Day, recipe demo at the Alamosa Market, dessert auction fundraiser for Alamosa community soccer program, Del Norte trail building and maintenance day, Bike to Work Day, SLV Local Foods Coalition, Integrated Nutrition Program Parent's Night). Another qualitative aspect of this study came from more formal school observations (e.g. school cafeteria, PE classes, recesses, and classrooms), as well as informal and formal interviews with elementary school students and school staff. This aspect of this study not only provided context to the quantitative data collected through the Healthy Family Project, it also provided a richer picture of life in the San Luis Valley, and a better understanding of typical dietary and physical activity patterns in the Valley. These patterns could then be compared to those of the smaller subsample of children in the Healthy Family Project in order to determine if they were representative of other children in the Valley. This section provides a brief description of this more qualitative part of the study.

The stories and contextual information used in conjunction with the data analysis came from notes collected while I resided in Alamosa (the largest town in the Valley) between April 2007 and January 2009. An important aspect of understanding the food habits and physical activity patterns of children is not only learning about the types of foods and places available for physical activity in the community, but also which resources are most commonly used by community members. In order to learn about community resources and their use, I spent a lot of time frequenting the local stores, restaurants, parks, community recreation center, and was a member of the local gym in Alamosa. I also volunteered at community events. For example, I had the opportunity to volunteer at one of the aid stations during Bike to Work Day in Alamosa. This aid station happened to be at Cole Park, which was one of the main stops for the majority of participants. During the event, I was able to spend the morning talking to other volunteers at the station, as well as participants who stopped at the station. The volunteers included local police officers, coordinators for the Valley chapter of “Live Well” Colorado, and a couple of public health nurses from Alamosa County, all of whom were happy to talk about their own, other members of their families and friends normal eating and physical activity patterns, as well as their views on community resources. Although many of the conversations did not involve talking about children’s eating or physical activity habits, they were informative and provide some insight into factors that may affect dietary habits and physical activity among adults in the community. For example, on this day, I spent a fair amount of time talking to a police officer about his thoughts on the dietary habits of police officers in the Valley. In his opinion, officers, especially those who worked the night shift, had “poor” diets. He attributed to the limited types of foods accessible to officers in the middle of the night; mainly processed “junk” foods (e.g. chips, cupcakes, cookies etc.) sold at gas stations and convenience stores. He commented that “its difficult when you are sitting in your car, on patrol at 3 in the morning and you get hungry…..the only thing you can do is run into the 1st stop over there and get a pop and chips…” In this case, community resources (food access in the middle of the night) an occupation (police officer on the night shift) were both influencing diet.

In addition to volunteering for community events, I was able to meet more members of the community, including faculty at the college and some local business owners, when I joined the local gym and cycling club, and participated in the club's events and weekly group rides. Participation in all of these activities allowed me to interact with many different Valley residents with varying incomes and professions. Many had young children, while others had adult children and grandchildren. These social interactions allowed me to talk to people in a more comfortable, informal setting, and observe daily life in the Valley without being seen as an outsider or researcher. Finally, all of these activities gave me the opportunity to make new friends, with whom I still talk and see occasionally.

One example of how just frequenting businesses allowed me learn more about the community, was through my membership at the local gym. I found that the gym was a great place for social interactions. The gym itself was relatively small, and membership dues were inexpensive compared to large corporate gyms in Denver and Boulder (e.g. 24-Hour Fitness, Rally Sport). As a result the members and class instructors were diverse; working in many different occupations (teachers, court reporters, doctors, students, retail staff and construction workers) and some living in different towns in the Valley. My gym membership not only benefited my mental and physical health while I lived in Alamosa, it also provided me with a means to engage in many informal conversations with other members and gym's staff. There was always time to visit with other members before the Pilates class in the morning, and before and after the Spin (indoor cycling) classes in the evenings. Often, these short conversations involved parents talking about their children, or one of the school teachers talking about upcoming events at the school. For example, one parent would often talk about her son and his activities (basketball, school etc.) before class. Another example was the OB/GYN doctor who participated in the early morning exercise classes. He often talked about his family and grandchildren, but he also talked about happenings at the hospital; especially when they involved him delivering a new baby. By the end of my stay in Alamosa, I had become very familiar with all of the regular gym members, running into them in other settings (restaurants, stores, community events); there was even a "going away" party held for me the week before I moved from Alamosa.

Aside from informal social interactions and observations that occurred in local businesses, participation in community events was also important for learning about community resources available to families, as well as those that are used most frequently. During my residence in Alamosa, I volunteered and/or attended at a number of different types of community events, which again allowed me to directly participate in the community, observe people and have informal conversations with adults and children. One example of a community event which functioned as both social gathering and a community resource was the Alamosa Farmer's Market. The Farmer's Market was held every Saturday in Alamosa during the summer and fall months. It was a great place to meet local famers and artisans, as well as run into local community members and catch up and the happenings of the previous week. Aside from a social gathering, the farmer's market also served as an educational resource to teach people new recipes for locally grown vegetables, a resource for low some low income families that may not otherwise purchase fresh fruits and vegetables offered at a farmer's market, and a guaranteed income for some of the local farmers participating in WIC's (Women Infants and Children) Healthy Habits program

The Healthy Habits program provided vouchers to women who received food assistance from the WIC program. These vouchers were only good for food purchases at the Alamosa

Farmer's Market, and the goal was to provide low income mothers with access to fresh fruits and vegetables. At the end of the day, farmer's turned in the vouchers they had received, and were reimbursed with cash. In addition to the vouchers, the program had a mobile kitchen vehicle (MOKI) which was parked at the Farmer's Market. Each week, volunteers would present a recipe demonstration that included the foods sold at the market that week. Volunteers prepared samples, and handed out copies of the recipes. The volunteer's name and recipe was printed in the local newspaper the week before the demo, and local news channel often videotaped and interviewed the volunteers. By 2008, this program had become quite popular, and the MOKI was often one of the most crowded places at the Farmer's Market.

While most of the above experiences only resulted in informal observations and conversations, they were essential to a deeper understanding of life in the San Luis Valley, learning about the types of food and physical activity related community resources which are available and used, as well as and adding a broader perspective to observational data collected in the schools and through the Healthy Family Project.

Another important qualitative aspect of this study was the time spent in many of the Valley schools. During the school year, children spend the largest percentage of their day at school. Therefore, the observations I made while visiting elementary schools in the Valley were important for understanding the role of the school environment in shaping children's daily dietary and physical activity patterns. Between 2007 and 2009, I made several visits to 12 different elementary schools, and one high school in the Valley. These schools were located in different counties, and varied in size and characteristics. Some schools were elementary schools housed with the district's middle school and high school. Some elementary schools housed kindergarten through 5th grade, while others housed only 2nd and 3rd grade, or 3rd through 5th

grade. Some of the schools were very small with just 50 students (K-5), and others had over 300 for just 2nd and 3rd grade (Table 1.1).

Table 1.1. Characteristics of elementary schools visited between 2007 and 2009

County	Town	School District	School Name	Grades	Students*	% Eligible Free/Reduced Lunch*	Middle and High School buildings attached?
Alamosa	Alamosa	Alamosa RE-11J	Boyd	2nd-3rd	330	74.1%	No
Alamosa	Alamosa	Alamosa RE-11J	Evans	4th-5th	327	71.3%	No
Alamosa	Hooper	Sangre de Cristo RE-22J	Sangre de Cristo	K -5	138	64.2%	No
Conejos	Antonito	South Conejos RE-10	Guadalupe	K- 5	104	82.3%	No
Conejos	Sanford	Sanford 6J	Sanford	K-5	161	72.5%	Yes
Costilla	San Luis	Centennial R-1	Centennial	K-5	97	89.03%	Yes
Rio Grande	Del Norte	Del Norte C-7	Underwood	K- 5	273	66.3%	No
Rio Grande	Monte Vista	Monte Vista C-8	Bill Metz	3rd -5th	269	75.9%	No
Rio Grande	Sargent	Sargent RE-33T	Sargent	K-5	229	51.3%	Yes
Saguache	Center	Center 26-JT	Haskin	K-5	276	94.1%	Yes
Saguache	Moffat	Moffat 2	Moffat	K- 5	91	56.4%	Yes
Saguache	Saguache	Mountain Valley RE-1	Mountain Valley	K-5	51	71.5%	Yes

*Average number of students and % free and reduced lunch eligibility 2007-2009 elementary schools only (Colorado Department of Education 2007; 2008; 2009)

While the purpose of these visits was to collect data for other projects (School Environment Project and Integrated Nutrition Program), it provided the opportunity to observe classrooms, school cafeterias, PE classes and recesses in 11 different school districts in the Valley. As a part many of these visits, conducted key informant interviews with principals, school teachers, PE teachers, food service staff, school nurses, and in one case, high school students. In addition, I participated in focus group interviews with 5th grade students in five of the schools.

Observations of the school cafeteria, playground and PE classes were especially important for providing context to the data collected in the dietary recalls and objective physical activity measures (accelerometers). For example, comparing my observations with data reported in the recalls provided a sense of the quality, or reliability data in the recalls. Fortunately, the quantity and types of school foods reported were supported by the quantities and types of foods that I observed while visiting the school cafeterias.

Likewise, in addition to the observations that I made in the community, the observations and interviews from the schools were important for understanding some of the dietary patterns that emerged from the analysis of the quantitative dietary data. They provided an explanation for why certain some foods may have been consumed more than others, as well as some context for some of the dietary variation observed between school districts. For example, observing the school cafeterias was helpful in understanding patterns of beverage consumption among the children. It not only allowed me to determine the types of beverages available to students, but also, which ones were most popular among students. In addition, it also provided insight into the types of beverages that are encouraged by teachers and lunchroom monitors. The best example of this type of encouragement was in the lunchrooms; during all of my visits to the schools, there was some type of encouragement for children to drink their milk. For example, at one school a teacher walked around and encouraged children to eat and drink. During one occasion, she could be overheard encouraging children to drink their milk by saying, “you want to grow up and be strong right…..then you need to drink your milk, or you’ll be a wimpy little string bean…” At another school, children lined up to discard their lunch trays before they were allowed to go outside for recess. While the students were lined up, the teacher would shake their milk cartons to make sure that they had drunk enough, or finished their milk. If a student had a full milk carton, he or she was sent back to the lunch table to drink milk.

Just as the lunchroom observations were important for understanding dietary patterns, recess and PE observations were equally important for understanding some of the physical activity data collected through the Healthy Family Project. First, the observations allowed me to connect patterns of high physical activity to the recess and PE schedule of some schools, as well as see some variation in physical activity between schools. Second, the observations and interviews were important for understanding why children may or may not be active during the school year. For example, one principal talked about how the children needed a better place to play and the school needing a better playground, but not having the budget for it. Other principals also had concerns with the budget, and some schools simply could not afford to hire a PE teacher. At some schools, the classroom teacher would teach PE once or twice a week.

In other interviews, teachers and principals talked about the importance of physical activity and serving as role models to encourage children. For example, one principal was training for a triathlon, and talked about how she tried to get children excited about running, by going out and running around the school’s track with them. At another school, the PE teacher showed students how to do different activities by doing them with the class. Her motto was “if they're [the children] doing it during the class, then we are too". The same school had also implemented the "Lap a day before you play" and "Walk a mile for a smile" programs. In the first, children had to walk or run a lap around the playground before they started doing other things at recess. The latter program encouraged children to walk, run and hike even when they were not in school. For this program, children would write a note every time they walked, hiked or ran, at the end of the week, their mileage was totaled. For each ¼ mile children would get part of a happy face. Children who had walked a total mile got a happy face drawn on their hand. The total mileage for all of the children was tracked throughout the school year on a giant map of the United States displayed in the school cafeteria. Each year, the school would start in Colorado set a goal for another place on the map; each mile was recorded on the map in a line. In the first year of the program, the children had walked enough miles to go from Colorado to Disneyland.

The experiences described above are just a small number of stories that came from my time spent living the Valley and visiting the schools. There are many more, although they are not all included in the chapters of this study. Nevertheless, as previously mentioned, living in the community, participating in community events, and spending time in the schools were an essential part of this study. While this study tested the hypotheses using quantitative data from a small sample of elementary school children, the qualitative component was also important. Although, the examples and stories in this study came from many informal observations, they provided the context necessary for really understanding dietary patterns and physical activity of the children in the San Luis Valley by going beyond the sample of children studied from Healthy Family Project.

Summary of study and research question

The present study tested a number of hypotheses regarding diet and physical activity among the children in the San Luis Valley Health Family Project, using a combination of quantitative data collected from the Healthy Family Project, and qualitative data collected from observations made throughout the Valley. The following chapter provides the reader some background details about the San Luis Valley, as well as a discussion of why researchers have been interested in the Valley. Following Chapter 2, there are four substantive chapters which examine many different variables that could be correlated with diet, physical activity and weight status among the children studied.

As discussed above, some of the variables included: household characteristics, school characteristics, seasonal effects, parental influences, and town location relative to restaurants and stores. However, each chapter and the hypotheses tested were developed from the following research question:

> *Q1:* How do local social, cultural and environmental factors impact dietary intake physical activity and weight status among children in the San Luis Valley Colorado?

CHAPTER II:

THE RESEARCH SITE

Introduction

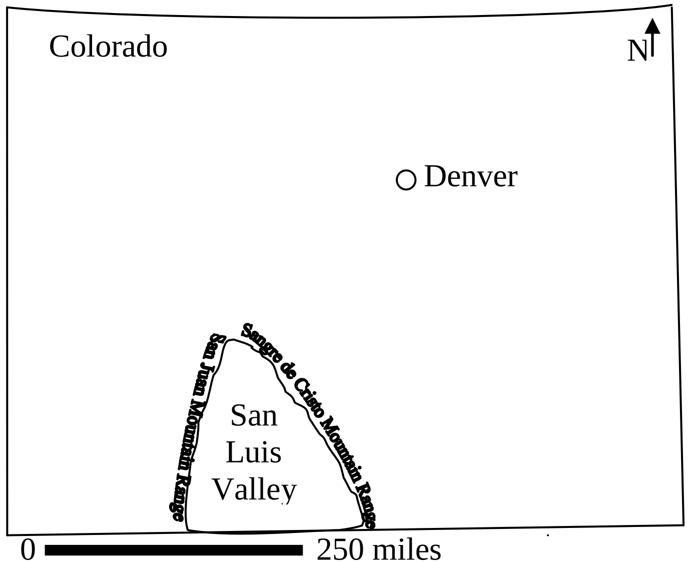
All of the research for this study took place in the San Luis Valley, located in south-central Colorado, approximately 240 miles southwest of Denver. The Valley has been characterized as a rural, biethnic, low-income community (Belansky et al. 2006; Lopez et al 1995), and previous research has identified a relatively high prevalence of obesity and type 2 diabetes, as well as low levels of physical activity and high dietary fat intakes among adults living in the Valley (Baxter et al. 1993; RMPRC 2005; Marshall et al. 1995; Lopez et al. 1995). However, until more recently, the majority of research has focused on adults. The purpose of the current study was to examine the biocultural aspects of physical activity and dietary behaviors among elementary school children living in the San Luis Valley, and provide contextual data for a larger project.

The San Luis Valley has a number of historical and geographic characteristics which make it different from other rural parts of Colorado. Some of these characteristics may impact the dietary and physical activity patterns of children living in the Valley. The purpose of this chapter is to discuss some of these characteristics which will include: 1) geology and climate; 2) history of settlement; 3) current economy and economical status; and 4) a brief description of research in the Valley.

Geology and Climate of the San Luis Valley

The San Luis Valley is a semi-arid intermountain basin which lies between two mountain ranges: the Sangre de Cristo Mountains on the east and the San Juan Mountains on the west (Figure 2.1).

Figure 2.1. Schematic of the location of the San Luis Valley in Colorado



The San Juan Mountains contain the headwaters of the Rio Grande River which flows southeast through the Valley and through New Mexico; the river provides surface water resources and fills groundwater reserves in the Valley floor (McNoldy and Doesken 2007). The Valley floor is about 100 miles long, 50 miles wide with an average altitude of about 7500 feet above sea level; although the peaks of the surrounding mountain ranges, such as Bear Peak and Kit Carson Peak in the Sangre de Cristo Mountains, can reach over 14, 000 feet above sea level (McNoldy and Doesken 2007).

The Valley is characterized as semi-arid because the surrounding mountains influence the climate by causing a rain shadow effect, with the San Juan Mountains to the west having the greatest impact. Storms build and enter the San Juan Mountains, but lose all of their moisture before they get over the Valley floor. As a result, the Valley receives very little precipitation (7 inches per year). In contrast, the surrounding mountains receive large amounts of annual precipitation and snow (30-48 inches of rain and 400 inches of snow respectively) (McNoldy and

Doesken 2007), resulting in significant runoff into the Rio Grande River, as well as drainage into two large underground aquifers, all of which supply the Valley with water.

Temperatures can range from very cold (below zero degrees Fahrenheit) in the winter to hot (90 degrees Fahrenheit) in the summer. The annual average temperature is 41 degrees Fahrenheit; however, the cold winter temperatures in the Valley put it in the top 20 coldest locations in North America (King 2007).

The average growing season is 90 -110 days with an average of 100 frost free days per year (San Luis Valley Focus Area Committee 2000; Mix et al. 2010). Despite the relatively cool, arid environment and short growing season, irrigation agriculture has been successful in the Valley since the first permanent settlements were established, and remains an important economic strategy for many residents. The success of irrigation agriculture has also allowed the Valley to be one of the major agricultural regions in Colorado. Agricultural plots cover 1.4 million hectares in Valley, producing the majority of Colorado's potato crops as well as a large proportion of the state's Alfalfa (Mix et al. 2010).

Settlement and farming in the San Luis Valley: A brief history

Prior to the mid-1800's, there were no permanent farming settlements in the Valley; however, it contained a variety of plant resources as well as moderately large populations of both large and small game, including: wild horses, elk, pronghorn, mountain sheep, mule deer, bison and rabbits. These resources were primarily used for seasonal hunting by at least four Ute kinship groups (Mouache, Tabeguache, Uncompahgre and Capotes). In the nineteenth century, the Valley also became an important resource for fur trappers (Andrews 2000; Hammond 1976), and later provided farming plots Spanish farmers moving north from New Mexico.

Texas, New Mexico and Colorado were all important areas for early Spanish settlement. In 1598, Don Juan de Oñate, accompanied by 30 families and servants, began moving north from Mexico into Texas and New Mexico. During this period, permanent settlements began to develop throughout the southwest, but did not reach southern Colorado until the early to mid nineteenth century, when population densities increased and trade routes began to move through northern New Mexico.

In 1680, the Pueblo Revolt drove most of the Spanish settlers out of Northern New Mexico; however, in a few years following the revolt, Spanish families began return to Northern New Mexico, occupying areas including Ojo Caliente, Taos and Chama, and by 1790, Northern New Mexico had become densely populated with Spanish farms, ranches and small villages called *entradas* (Andrews 2000; Norman 1992). In addition to an increased number of Spanish farming settlements, the fur trade had become an important part of the economy in Northern New Mexico. In 1822, the Sante Fe trail was completed which brought major trade routes through Northern New Mexico and allowed for the Rocky Mountain fur trade to expand. As a result, fur trappers began to pass through the San Luis Valley seeking pelts for trade (Hammond 1976).

With increasing population densities and decreasing resources in northern New Mexico, as well as Mexico's increasing interest in populating the southwest, residents in New Mexico began to expand to the north. One individual who sought to expand settlement north into the San Luis Valley was Atanasio Trujillo, who, after a fur trapping expedition in 1847, encouraged other families within his village of *El Rito* (in Northern New Mexico) to join him in establishing a colony north of *El Rito* in the San Luis Valley. Around the same time, the Mexican government was encouraging other Spanish families to settle in the San Luis Valley through the Conejos and Sangre de Cristo land grants, issued between 1842 and 1844 (Andrews 2000). However, it wasn't until 1850, that the first permanent colony was actually founded in the Valley. In March of 1849, Atanasio Trujillo met with Ute leaders in the Valley, with whom he had developed a long standing friendship; the two parties agreed on a settlement area and remained allies. That same year, Trujillo and a group of families planted a field of crops in the San Luis Valley. The following year, Trujillo and the families returned and settled permanently in the Valley. This first settlement was called *Los Rincones* (Andrew 2000). A year later, in 1851, another group of 50 families founded the town of San Luis, west of *Los Rincones* in the southern part of the valley. By 1859, agricultural production had increased, and the San Luis People's Ditch was built to support increased farming in the area (Carlson 1973).

Although expeditions passed through northern part of the Valley in search of railroad routes, permanent settlements were established later than those in the southern part of the Valley. Following the Homestead Act of 1862 and the end of the Civil war, large groups of Anglo settlers from the Midwest and Utah began to settle in the northern part of the Valley; these settlers began to expand their subsistence agriculture into small-scale commercial agriculture (Carlson 1973).

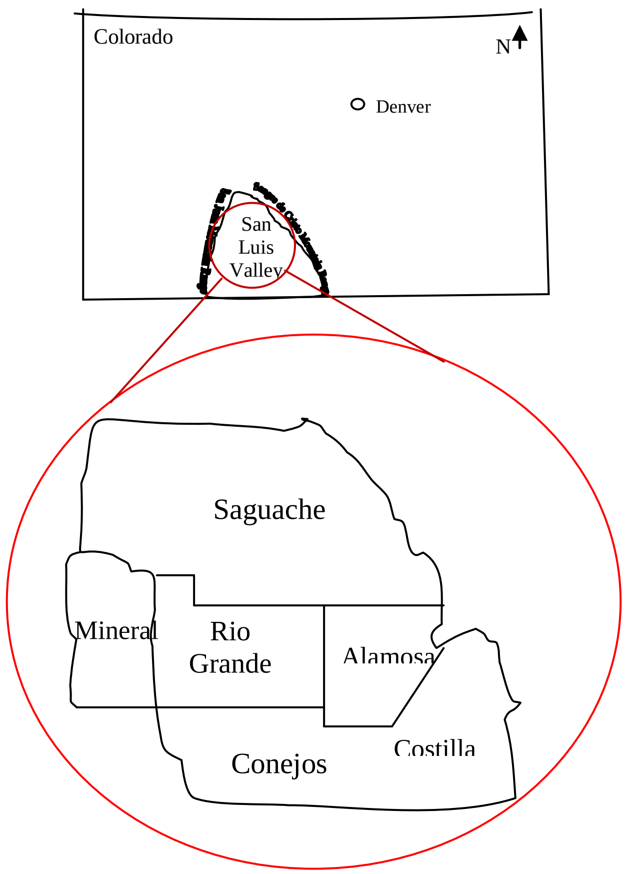
In 1870, gold and silver were discovered in the San Juan Mountains and the small mining towns of Del Norte, Creede and Summitville were founded. Most of the mines closed in the early 1900's, except for the Summitville mine, which remained in operation until 1992 (Bigelow and Plumlee 1995). While the town of Summitville was abandoned, Del Norte and Creede remain populated.

In 1878, the Denver to Rio Grande Railroad was built and the town of Alamosa was founded. Alamosa served as a main hub and major train stop; this combined with a railroad system provided local farmers and ranchers with access to other communities throughout the state, which allowed for the development of commercial agriculture (Carlson 1973); the train station also allowed the town of Alamosa to grow into the largest town in the Valley.

The San Luis Valley Today

Currently, the San Luis Valley consists of 6 counties (Mineral, Rio Grande, Alamosa, Saguache, Conejos and Costilla), with a total population of about 48,460 residing in over 50 different and towns within these counties (Figure 2.2.) (United States Census Bureau 2010; Colorado Department of Public Health and Environment 2008).

Figure 2.2. Counties in the San Luis Valley, Colorado



Located in the center of Alamosa county is the town of Alamosa. It is the largest and most developed of the towns, and serves as the major retail, higher education and medical hub for Valley residents. Alamosa county has a total population of about 9000, and is the home of the Adams State College and Trinidad Jr. College campuses, a large community hospital, retail and grocery stores (Wal-Mart, Safeway, City Market, JC Penny, AutoZone and NAPA autoparts), golf course, community recreation center, Boys and Girls Club, chain hotels (e.g. Best Western, Comfort Inn, Holiday Inn, Inn at the Rio Grande), the majority of fast food and family restaurants and courthouse. The majority of businesses are located off of Highway 160, which is the main road passing through the center of Alamosa. The eastern portion of Highway 160 contains older buildings, and a “Main Street” business area, whereas the western part of the highway leads out of town, is more spread out, and contains most of the newer fast food and larger, chain stores (e.g. Wal-Mart, McDonalds, Long John Silvers, City Market) (Figure 2.3 and Figure 2.4).

Figure 2.3. Older part of Alamosa, eastern portion of 160.

Figure. 2.4. Newer businesses on the western portion of 160.

Much like in the 1800's, agriculture is still an important part of the local economy, especially for the smaller towns outside of Alamosa. About 25% of the total land area in the Valley is used for farming and ranching, and over half of the farmland used for irrigation agriculture (Thorvaldson and Pritchett 2005) (Figure 2.5).

Figure 2.5. An example of one of the many farms in the Valley, a potato farm located north of Alamosa.

In 2000, 116 million (22%) of the $529 million dollars of basic income coming into the Valley was based on agriculture. Agribusiness jobs concentrated in Rio Grande, Saguache and Alamosa Counties made up 57% of all basic employment (San Luis Valley Development Group 2001). Some of these jobs included jobs at the potato processing and packing plants located in Center and Monte Vista.

In addition to being an important economic contribution to the Valley's income, crops grown in the Valley make a significant contribution to Colorado's produce production. For example, the San Luis Valley produces 92% of Colorado's potatoes and is 5th largest potato producer in the United States. Malting barley for beer is also an important part of the agricultural economy. In 2001, Adolf Coors purchased 80% of its barley from farmers in the Valley. Today, the majority of barley used by the Molson-Coors brewery in Golden, Colorado is purchased from farmers in the Valley (San Luis Valley Development Group 2001).

Schools (primary, secondary and colleges), local government, and the hospital also provide a large proportion of the jobs for residents in the Valley. However, despite the Valley's contribution to State's agricultural production and other available jobs, the median income for the Valley is still the lowest in the State. In 2000, the median income for the entire Valley was $28,138, whereas median income for the State was $47, 203 (a $19, 065 income gap). While some of the counties had higher median incomes, others were very low. For example, Mineral, Rio Grande and Alamosa counties had median incomes higher than the Valley average ($34, 844, $31, 836 and $29, 447 respectively). On the other hand, median incomes in Costilla, Conejos, and Saguache were lower than the Valley average ($19, 531; 24, 744, and $25, 495 respectively). In addition, there was a small proportion of families with relatively high incomes. In 2000, there were 727 families which had reported incomes over $100, 000; most resided in Alamosa County (San Luis Valley Development Resources Group 2001), were likely invested in the potato agribusiness. Recent census data indicates only slight changes in income. In 2008, the median income for the Valley remained lower than the state average ($34, 597 vs. $57,184), with an income gap of 22, 587. Mineral, Rio Grande and Alamosa counties still had the highest median incomes ($46,394, $37, 353, and $34, 681 respectively), while Costilla, Conejos and Saguache still had the lowest incomes ($25, 208, 30,747, 33, 198) (United States Census Bureau 2010).

With low median incomes, the percentage of people living in poverty continues to exceed the state average. In 2003, 23.6% of the children under 18 years of age were living in poverty compared to 12.8% for the rest of the state. Likewise, 19.1% of all persons were under the

Federal Poverty Level, compared to 9.5% for Colorado. More recent data indicates that poverty is still prevalent in the Valley. In 2008, 27.6% of children and adolescents (under 18 years of age) were living in poverty compared to 12.8% for the rest of the state, and 21% of all persons in the Valley were living below the Federal Poverty Threshold compared 11.2% for the state (United States Census Bureau 2010; San Luis Prevention Coalition 2007).

These data suggest that there has been, and remains, some degree of income disparity in and between the counties in the Valley. It is likely that the higher incomes are associated with the larger farming and ranching operations in Mineral, Rio Grande and Alamosa Counties where the highest incomes were reported. On the other hand, lower incomes are associated with the smaller less populated counties, or those with smaller, less industrialized farming operations, such as Costilla and Conejos counties. Those families within the lower income households are likely to have the most limited access to health care, specialty foods and stores and private fitness centers or studios, or club sports. As such, children from these lower income households may have less access to “healthful” foods such as fresh fruits and vegetables, and fewer opportunities for physical activity.

Water resources and their impact on Valley economy and health

In addition to farming and agriculture, water has played an important role in the Valley’s economy and health. The arid environment and the widespread use of irrigation agriculture in the Valley make water an important resource for residents. Historically and more recently, local residents have had to deal with a number of water issues surrounding water allocation, water use rights and availability which have had some negative impacts on the local economy, and may have contributed to lower median incomes in the past. Five of the major water issues in the

Valley include: the Treaty of 1906, the Rio Grande Pact, Court battles with American Water Development Incorporated, recent drought conditions and contaminated water supply.

In the late 1800's, a series of drought conditions affected farmers in New Mexico, Texas and the Republic of Mexico. Residents in these areas observed that the valley wide irrigation system in the San Luis Valley had diverted water from the Rio Grande, resulting in less water flowing south to New Mexico, Texas and Mexico. This began a series of complaints and lawsuits. In 1898, the Republic of Mexico sued the United States for water from the Rio Grande, and in 1906, the Treaty of 1906 was signed, which required the United States to allocate 60, 000 acre feet of water to Mexico annually. The treaty affected water use for irrigation in the Valley, especially the southernmost part, by curtailing or limiting use in order for the United States to meet its treaty commitment. In 1916, some of the limitations on water were lifted when Elephant Butte Reservoir was constructed in New Mexico to help deliver water to Mexico. In addition, water users in the Valley began to privately fund and construct reservoirs and more irrigation drains; which reclaimed some of the water lost from the Treaty of 1906 (United States Bureau of Reclamation 2001). The treaty between Mexico and the United States resolved water allocation issues between the two countries, but did not resolve water issues between Colorado, New Mexico and Texas; New Mexico and Texas were still receiving less water from the Rio Grande than Colorado. In 1923, discussions on equitable water distribution between the states began and in 1938, the Rio Grande Compact was signed; it required each state to allot a certain amount of water to the other states and is still in effect today. Presently, water is allocated through Elephant Butte Reservoir, but a large amount of water is also allocated through the San Luis Valley Closed Basin Project. This project, approved in 1988, salvages unconfined ground water and some surface water that would normally be lost to evapotranspiration, and pumps it into the Rio

Grande through a 42 mile conveyance channel (a series of 115 miles of pipeline and 170 water salvage wells). In addition to meeting the State's water commitments, the San Luis Valley Closed Basin Project also provides water to three wildlife habitat areas in the Valley (United States Bureau of Reclamation 2001).

Another major water issue occurred in 1986 when American Water Development Incorporated (AWDI) purchased land in the Valley and filed an application to build a pipeline, and pump 200, 000 acre- ft of water per year out of the Valley into subdivisions in the Denver-Metro area, and reducing water to local farming operations. Farmers, ranchers, government officials, and other local residents fought the petition, and in 1991 after several years of litigation, the application was dismissed (Emery 1995). After the application was denied, the AWDI sold the company's land to a private ranching company who then sold the land to The Nature Conservancy. The Conservancy founded the Baca Wildlife Refuge on the land. Today, the aquifer is used not only to support the refuge but also for water use by surrounding residents (The Nature Conservancy 2007).

More recently, drought conditions have had an impact on agriculture and economy in the Valley. Lower than average precipitation in the San Juan Mountains resulted in reduced snowmelt and runoff into the Rio Grande and underground aquifers. The reduced water supply reduced the amount of water available for irrigation and farming; several small farms suffered economically (Doesken et al. 2003). However, drought conditions have started to subside. In 2006, snowfall in the mountains was normal. During the summer growing season following 2006, rainfall in the Valley averaged 147% above normal. This increase in precipitation, followed by normal snowpack and rainfall has allowed for local farmers to recover from a number of lower than normal precipitation years (McNoldy and Doesken 2007; Doesken et al. 2003).

In 2008, water was the source of health and economic problems for some residents and businesses in Alamosa. Between March and April of 2008, water treated by the eastern Alamosa treatment plant was contaminated with salmonella. A number of residents fell ill, and there were at least two deaths related to the outbreak. The city responded to the outbreak by treating the water with high levels of chemicals, which left the water non-potable for several weeks. Residents were notified of the outbreaks through mass notices left on residence's doors, all of the primary and secondary schools as well as the college were temporarily closed.

The school closures interrupted the spring class and testing schedules. As a result, standardized testing (CSAP) was rescheduled, the semester was extended and students started classes an hour earlier than normal for the rest of the spring. This was a minor impact compared to the economic losses suffered by some businesses in the area. The largest impact was on restaurants using the city water system. Because the water could not be used to wash dishes or food, many restaurants in Alamosa had to close temporarily. Some of the larger, more established family restaurants were able to recuperate from the economic loss by cutting staff, shortening hours and limiting their menus for a couple of months following the outbreak. But, there were a few smaller businesses that could not recover their losses and were forced to close, and as a result, a number of individuals lost their jobs. Since the outbreak, a new water treatment system has been implemented, and Alamosa residents have not had any more problems. However, the city is facing a class action lawsuit from families who fell ill, or relatives of those who died as a result of the contaminated water supply.

Ethnicity

Because of the geographic location of the Valley, the population has remained relatively isolated, and since the early settlements in the mid to late nineteenth century, there has been very little expansion or new migration into the Valley. Today, just less than half of the residents in the Valley (43%) self identify as Hispanic, compared to the state of Colorado in which 18.9% self identify as Hispanic (Centers for Disease Control and Prevention/National Centers for Health Statistics 2008). Unlike other areas, such as Texas or California, the Valley has seen very little migration from Mexico and most of the residents emphasize their Spanish ancestry over Mexican or Native American ancestries (Bonilla et al. 2004).

There has been very little migration into the area, thus the Valley population represents a small, somewhat isolated gene pool, especially among residents in the southern part of the Valley (Mullineaux et al. 2003). As such, there has been interest in the genetic component related to the incidences of cancers and chronic disease among families in the Valley. Previous research identified a germline mutation in the *BRCA 1* and *BRCA 2* genes resulting in an increased risk for breast, ovarian and pancreatic cancer, and have linked the mutation to a founder effect in the Valley (Mullineaux et al. 2003).

In addition to cancer risks, the population has been found to be at high risk for type 2 diabetes, obesity and gall bladder disease, and has been the focus of studies examining related complex gene traits related to chronic disease (Bonilla et al. 2004; Hamman et al. 1989).

Epidemiologic Research in the Valley

Early research in the Valley focused on identifying chronic disease. For example, the San Luis Valley Diabetes study identified the prevalence and determinants of type 2 diabetes among adults in the San Luis Valley. Later in 1991, the IRAS (Insulin Resistance and Arthrosclerosis

Study) examined the relationship between insulin resistance and cardiovascular disease among adults in the San Luis Valley. Previous research has also reported a high prevalence of obesity (36.9% overweight and 19.6% obese among adults), low levels of physical activity and high intakes of dietary fat among adults living in the Valley (Alamosa County Survey 2008; Baxter et al. 1993; Swenson et al. 2005; Lopez et al. 1995)

More recently, there has been a shift towards Community Based Participatory Research where community members are directly involved in developing research projects and research serves as a resource for improving health among community members. In 1998, the Rocky Mountain Prevention Research Center (RMPRC) was established in Alamosa. The RMPRC is one of 35 Prevention Research Centers in the country, is funded by the Centers for Disease Control and Prevention, and works with the local community to develop research which addresses local health concerns.

The RMPRC conducts research through a network of community, academic and public health partners. A community advisory board helps identify community needs and research. In addition, individual projects have a steering committee, also made up of community members. These committees provide oversight on projects, help develop research questions and assist with project planning (Rocky Mountain Prevention Research Center). More importantly, the Community Advisory Board and Steering Committees seek to develop research projects which have sustainable and lasting effects. Thus, more recent studies have worked in partnership with the community, focusing on not only identifying the range of factors which may increase obesity or disease risk, but also developing long-term strategies which may mitigate these factors, promote healthy lifestyles and decrease obesity rates within the community.

There have been a number of projects through the RMPRC which have worked with community, schools and families to improve health outcomes. For example, two projects have worked with schools to improve the school nutrition and physical activity environment through the Integrated Nutrition and Physical Activity Program and School Environment Project (Belansky et al. 2006; Belansky et al. 2009). Recent research has also specifically addressed families. For example, a recent study used ethnographic data to identify factors which contribute to family decisions about physical activity and nutrition (Brett et al. 2002). Similarly, the PACT (Parents Advisors and Children Together) study was developed to address dietary and physical activity habits among families living in Alamosa with elementary school children. The study, a yearlong intervention sought to improve health among families with young children (2nd and 3rd graders) by increasing fruit and vegetable consumption and daily physical activity levels; the study also served as a pilot study for the later San Luis Valley Healthy Family Project. Families participating in the PACT study received up to 10 visits from a family advisor who worked with families to set nutrition nutrition goals and develop fun activities (Rocky Mountain Prevention Research Center 2007).

Following PACT, the San Luis Valley Healthy Family Project was developed. As previously discussed in Chapter 1, this study was a 12-month randomized control study designed to test the effectiveness of household based lifestyle coaching on nutrition and physical activity among families with, or at risk for type 2 diabetes. Unlike the PACT study which only included families with children attending one of the elementary schools in Alamosa, the Healthy Family Project included families from many of the towns in the Valley. The inclusion of families from outside of Alamosa provided a more representative sample of families living in the San Luis Valley. Some of the Valley towns represented by these families included: Hooper, Alamosa, Monte Vista, Sargent, Manassa, LaJara, Capulin, Romeo, Sanford, Ft. Garland, Del Norte, South Fork, and Center. These towns ranged from very small districts such as Capulin, to the largest town, Alamosa. Although the largest proportion of participating families had older children or no children at all, there was still a group of families with elementary school children representing the majority of school districts in the Valley. Because there were families with children representing the majority of counties and school districts in the Valley, the San Luis Valley Healthy Family Project provided the basis for the current study. As previously discussed, families participating in the Healthy Family Project, with children between 7 and 12 years of age were also invited to participate in a supplemental study which involved having a researcher observe and record the children's daily food intake and activities. The Healthy Family Project combined with the supplemental study, as well additional ethnographic observations in the schools and community provided a unique opportunity to examine the impact of community, household and school environments on energy balance among elementary school children living in a rural environment.

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CHAPTER III:

DIETARY INTAKE AND QUALITY AMONG ELEMENTARY SCHOOL CHILDREN PARTICIPATING IN THE SAN LUIS VALLEY HEALTHY FAMILY PROJECT, SAN LUIS VALLEY COLORADO

INTRODUCTION

With increases in the prevalence of overweight and obese children in the United States, Canada and Europe, there has been increased interest in understanding role of diet in shaping children's weight status. While energy intake is an important aspect of understanding this relationship, there has also been interest in understanding the relationship between diet quality and overweight; as well as the impact of the school environment on the diet quality and food choices (Clark et al. 2009; Hendy et al. 2005; Cullen et al. 2000; French et al. 2001). Previous studies have used diet quality indices such as: the Healthy Eating Index; Youth Healthy Eating Index; School Nutrition Dietary Assessment Study; and Canada's Food Guide to Healthy Eating to assess the impact of diet quality and the school environment on energy intake and growth and development among children; particularly with regard to childhood obesity (Briefel et al. 2009; Clark et al. 2009; Angelopoulous et al. 2009; Galloway 2007). The majority of these studies; however, examined diet among children living in densely populated areas. Aside from those published by Crooks (2000, 2003), there have been few studies which have examined dietary intake, dietary quality and dietary patterns among children living in small, low-income rural communities. To date, there have been no studies which have examined longitudinal changes in dietary intake and quality among rural children.

Despite the small body of literature, recent reports suggest that children, particularly those living in low-income rural communities, are at high risk for chronic disease, and being overweight and obese. In some communities, the obesity rates are higher than urban communities in the same area, as well as national averages (Mc Murray et al. 1999; Jackson et al. 2005; Williamson et al. 2009; Eichner 2008, Bruner et al. 2008). The pattern is similar for Colorado. Recent data from the Colorado Child Health Surveys (2004-2007) estimate that the percentage of overweight and obese children and adolescents living in rural Colorado exceeds that of children living in metropolitan areas in the state (Colorado Department of Public Health and Environment 2008). In addition to reporting prevalence, many studies also suggest that there may be a unique set of factors contributing to increased risk for obesity in rural communities, but less understood, are the specific roles of energy intake and diet quality in obesity risk among rural children.

The purpose of this study is to describe dietary intake among rural elementary school children participating in the San Luis Valley Healthy Family project, assess diet quality of this group, compare this group's energy intake to intake to Estimated Energy Requirements, and examine the relationship between energy intakes, diet quality and changes weight status over a 12-month period. It is expected that there will be some similarities between the children in this study, and those who have participated in previous studies in the United States (Briefel et al. 2009; Clark et al. 2009). Specifically, it is expected that there will be a positive association between energy intake and weight status. It is also expected that children with higher energy intakes will be consuming a wider variety of foods than those reporting lower intakes. Therefore, there will be an association between diet quality and energy intake.

In order to examine these relationships more closely, the following hypotheses were tested:

H_1: For all children in the sample, there will be no differences in reported total energy intake or diet quality between the baseline to 12-month measurement.

H_2: Children with higher BMI-for-Age percentiles will have higher energy intakes and higher Healthy Eating Index-2005 scores than children with lower BMI-for-Age percentiles children at both baseline and 12-months.

H_3: For all children, there will be a positive correlation between total reported energy intake and HEI-2005 scores at both baseline and 12-months.

H_4: Children who consume a higher number of foods at school will have a higher quality diet than children who consume a fewer number of foods from school.

METHODS

Study Site

The San Luis Valley of Colorado is a rural six county geographic area covering 8,000 square miles in south central Colorado, about 250 miles south of Denver, Colorado. Geographically the valley is relatively isolated, surrounded on 3 sides by mountain ranges (Sangre de Cristo and San Juan mountains) and only accessible from other parts of Colorado by two, 9,000 ft. mountain passes (La Veta Pass and Poncha Pass) (McNoldy and Doesken 2007).

The Valley was first settled in 1850 by a small group of farmers who moved north from New Mexico; the first permanent town (San Luis) was founded a year later by 50 families. Following these early settlements, the number of Spanish families receiving land grants from Mexico increased, and more families began to move north into the Valley from New Mexico. After the Homestead Act of 1862, non-Hispanic settlers from Utah and the Midwest began to move into the northern part of the Valley (Carlson 1973; Andrews 2000). Today, almost half of the residents in the Valley (43%) self identify as Hispanic, compared to the state of Colorado in which 18.9% self identify as Hispanic (Colorado Department of Public Health and Environment 2008). Unlike other areas, such as Texas or California, the Valley has seen very little migration from Mexico and most of the residents emphasize their Spanish ancestry over Mexican or Native American ancestries (Mullineaux et al. 2003; Bonilla et al. 2004).

In 2007, the total population in the San Luis valley was 48, 460, residing in over 50 small towns within six counties (Colorado State Demography Office 2008). Since 2007, there has been very little change in the population size of the Valley. Currently, Alamosa County is the largest area with a population of 15, 424 (US Census Bureau 2010), and contains the largest and most developed town of Alamosa. Alamosa is considered the “hub” of the valley because it has the largest business district and development, which includes three large chain grocery stores, fast-food restaurants, smaller chain restaurants and retail stores. Alamosa is also home to Adams State College, Trinidad State Junior College and the largest hospital.

Farming and tourism are the main sources of income for residents living in the Valley, and median incomes are lower than the state median. While there is some variation between towns, the median household income for the entire Valley is $34,597; where the median income for Colorado is $57,1848 (US Census Bureau 2010). In addition, percentage of people in the Valley living in poverty exceeds the state average. In 2008, 21% of the population was under the Federal Poverty Level, compared to 11.2% for Colorado (US Census Bureau 2010).

The Valley remains geographically isolated, and there has been little migration into the area since the earliest settlements in the late 1800’s, thus the population represents a small, somewhat isolated gene pool (Mullineaux et al. 2003). As such, previous research in the valley has identified a germline mutation in the *BRCA 1* and *BRCA 2* genes resulting in an increased risk for breast, ovarian and pancreatic cancer, and have linked the mutation to a founder effect in the Valley (Mullineaux et al. 2003). In addition, the population has been found to be at high risk for obesity, type 2 diabetes and cancer, and has been the focus of studies related to chronic disease as well as complex gene traits (Bonilla et al. 2004; Mullineaux et al. 2003; Hamman et al. 1989). Recently, however, research in the Valley has focused less on genetic predisposition for chronic disease and more on helping high risk families delay or prevent the onset chronic disease through weight management, diet and physical activity. This study included children from families considered to be at high risk for type 2 diabetes because: 1) an adult family member had been diagnosed with type 2 diabetes, 2) had a BMI of 27 kg/m^2 or greater, or 3) a first degree relative had diabetes.

Participants

Participants in the study were 40 children between 7 and 11 years of age (at baseline) from families participating in the San Luis Valley Healthy Family Project. Participants in Healthy Family project were scheduled for 3 clinic visits (baseline, 6 months, and 12 months) over a 12 month period. Each visit included a series of anthropometric measurements (height, weight, waist circumference and blood pressure), two 24-hour dietary recalls (7 days apart), and an interview which included questions about diet, physical activity, health care, and community resource use.

Written informed consent was signed by all participating adults in the family, and assent forms were signed by all participating children. All research was approved by Colorado Multiple Institution Research Board.

Demographic Characteristics

Information about household size was collected from adult household members when they first talked to a researcher about participation in the study. Both ethnicity and household income information were collected from the primary caregiver during the baseline and 12-month interviews. Children's ethnicity was based on self-reported data. During clinic interviews parents and their children were asked the following questions about ethnicity: 1) “Is *(name’s)* Spanish or Hispanic orgin?” (yes or no, don’t know, refused); 2) “If yes, which of the following best describes *(name’s)* heritage” (Mexican, Mexican American, Chicano, Cuban, Puerto Rican, Guatemalan, Other Spanish/Hispanic) 3)”What is *(name’s)* race?” (White, African American, Black, Asian, Pacific Islander, American Indian, Alaska Native, Other, Don’t know, Refused).

Household income was also based on self-reported data collected during the baseline and 12-month clinic interviews. During the interviews primary caregivers were asked about their occupation, and were asked to report their household income by income brackets of $10,000/ year and up (e.g. 0-$9,999/year) (Table 3.1).

Table 3.1. Income brackets and codes used in the Healthy Family Project.

Income Bracket
0 - $9,999/year
10, 000 – 19, 999/year
20, 000 – 39,999/year
40, 000 – 49,999/year
50, 000 – 59, 999/year
60, 000 – 69,999/year
70, 000- 79, 999
80, 000 and up

Poverty Status

Poverty status was determined by comparing the date of the data collection visit, household size and reported household income to the same year’s United States Federal Poverty thresholds for household size and income (United States Department of Health and Human Services 2009). For this study, participants were classified as being above or below the United States poverty threshold.

Anthropometry

Height, weight and waist circumference measurements were collected during baseline, 6-month and 12-month clinic visits for the Healthy Family Project. Height was measured to the nearest 0.10 cm using an Accustat stadiometer (Genentech Inc). Weight was measured to the nearest 0.5 kilogram using a balance beam scale and waist circumference was measured to the nearest 0.10 cm with a measuring tape.

BMI was calculated as weight (kg) / height (m^2). Age and gender specific BMI-for-Age percentiles were calculated and summarized using the BMI calculator tool provided through the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention 2009). Weight status classification was also based on BMI-for-Age gender specific percentiles from the Centers for Disease Control and Prevention (2000). Based on age and gender specific BMI-for-Age percentiles, children were classified as underweight, normal weight, overweight and obese following the more recent Centers for Disease control expert committee recommendations (Barlow et al. 2007) (Table 3.2).

Table 3.2. BMI-for-Age percentiles based weight status classification.

Percentile Range	Weight Status
Below 5th percentile	Underweight
5th – 84th percentile	Normal weight
85th – 94th percentile	Overweight
95th percentile or above	Obese

Dietary Intake

Dietary intake was assessed using two 24-hour recalls; one collected at baseline and one collected at 12-months. As a part of their scheduled baseline and 12-month clinic visits, participating children completed a dietary recall interview with a trained data collector using The

Nutrition Data System (University of Minnesota). Recalls were conducted year-round, during the week between Tuesday and Saturdays, with the exception of 4 individuals who completed their baseline interview on a Monday. Children were also asked to return within 7 days to complete a second 24-hour recall interview following their baseline and 12-month clinic visits. Not all of the children completed the second recall, and for those who did complete both, there were no significant differences in intake values or food types reported between the two recalls ($p = 0.785$).

In addition, NHANES healthy eating index scoring (HEI) standards have been designed to be used with a single dietary recall, and previously reported dietary data using index scores are based on single recalls (Kennedy et al. 2005; Guenther et al. 2008; Fungwe et al 2009; Angelopoulos et al. 2009; Bruner et al. 2008; Clark et al. 2009). In order to utilize the scoring standards properly, have a data set comparable to previous studies, and examine potential longitudinal changes in dietary reporting, intake and quality, energy intake and dietary scores were based on a dietary recall from both the baseline and 12-month visits were used in this analysis. All children completed the first recall, but several did not complete the second recall at the baseline, 12-month or both visits. As a result, the first recalls were used in this analysis.

At the beginning of the recall interview, children were asked if their intake on the previous day was usual, more than usual, or less than usual. The children were then asked to recall and describe all of the foods that they consumed from the time that they awakened in the morning to the time that they went to bed the night before. During the interview, children were asked to provide detailed descriptions of the ingredients, preparation styles, portion sizes of foods and beverages, as well as the time and location of snacks or meals from the previous day. In order to obtain accurate portion size estimates, children were asked to use sample cups, plates, glassware, bowls and cutouts which had been marked with graduated measurements (example 8 oz, 4 oz, etc.) to describe the amounts.

The Nutrition Data System (University of Minnesota) was used to calculate daily intake for kilocalories, fat, carbohydrates and protein. Macronutrient values were then used to calculate intake per kilogram of body weight.

Total macronutrient intakes and macronutrient intakes per kilogram of body weight for both baseline and 12-month recalls were compared by gender, household income, poverty status and weight status. All of the baseline intake values were compared to 12-month intake values to assess any longitudinal changes. Finally, the children's macronutrient intakes were compared with the Dietary Reference Intakes (DRIs) Estimated Energy Requirements (EERs) (Institute of Medicine 2005).

Diet Quality

Diet quality was assessed using the Healthy Eating Index-2005 (HEI-2005). The Healthy Eating Index is a multi-component, dietary assessment tool used to measure compliance with key diet recommendations of the 2005 Dietary Guidelines for Americans (Guenther et al. 2007), and has been used in conjunction with 24-hour dietary recalls from adults and children participating in recent National Health and Nutrition Examination Survey (NHANES) (US Department of Agriculture 2009).

An HEI-2005 score was calculated for each child's baseline and 12-month recall following the guidelines used to assess diet quality of children participating National Health and Nutrition Examination Survey (NHANES) (Guenther et al. 2007). Each score ranged between 0 and 100 and was based on the sum of scores from 12 index components (Table 3.3), representing the major food groups found in My Pyramid and Dietary Guidelines for Americans (Guenther et al. 2007). Once the foods were assigned to a component group, the reported intake amounts were converted to cup, ounce, or gram equivalents per 1000 kcal of intake. In addition, saturated fat and discretionary calories, or SoFAAS (energy from solid fats, added sugar and alcohol) were calculated as percentages of total kcal. Following the standards by Guenther et al. 2007, a minimum score of 0 was used to indicate no reported intake. A maximum score of 5, 10 or 20 was used to indicate the recommended intake was met (Table 3.3). For intakes which fell between 0 and the minimum recommended intake, intermediate scores were calculated based on the maximum score and proportion of servings to the recommended intake and maximum score (Appendix 3.1).

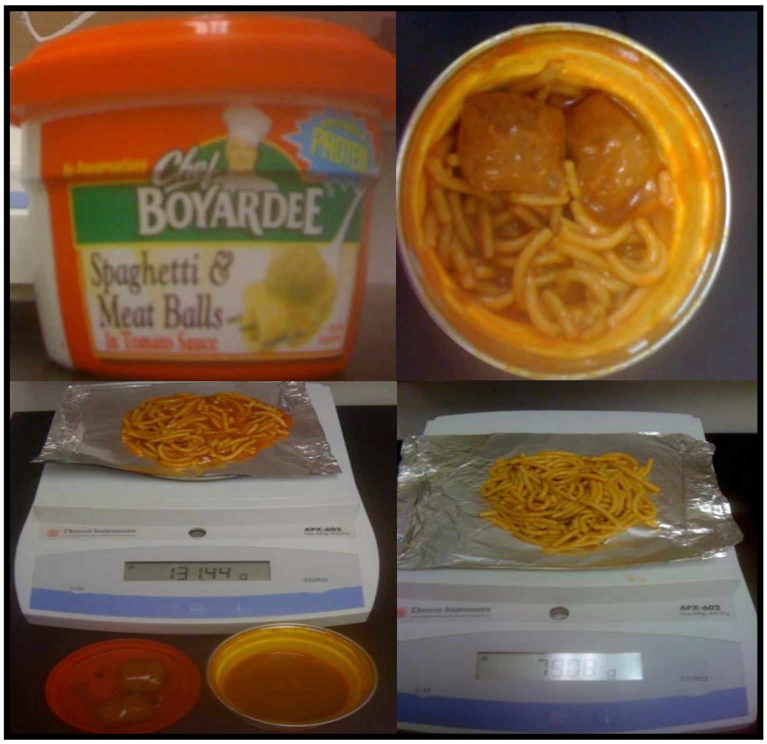
Table 3.3. Healthy Eating Index-2005 (HEI-2005) components and scoring standards.

Component Group	Minimum Score	Maximum Score	Recommended Intake
Total Fruit	0	5	$\geq$ 0.8 cup eq./1000 kcal
Whole Fruit	0	5	$\geq$ 0.4 cup eq./1000 kcal
Total Vegetables	0	5	$\geq$ 1.1 cup eq./1000 kcal
Dark Green and Orange vegetables	0	5	$\geq$ 0.4 cup eq./1000 kcal
Total Grains	0	5	$\geq$ 3.0 oz eq./1000 kcal
Whole Grains	0	5	$\geq$ 1.5 oz eq./1000 kcal
Milk	0	10	$\geq$ 1.3 cup eq./1000 kcal
Meat and Beans	0	10	$\geq$ 2.5 oz./1000 kcal
Oils	0	10	$\geq$ 12 g./1000 kcal
Saturated Fat	0	10	$\leq$ 7% of total energy
Sodium	0	10	$\leq$ 0.7 g/1000 kcal
Calories from SoFAAS	0	20	$\leq$ 20% of total energy

After Guenther et al. (2007)

In some cases, mixed dishes were reported in the recalls. In these cases, a recipe and the USDA food nutrient database were used to determine the amounts of each individual food in a mixed dish, following the method used by Kennedy et al. (1995) for the original Healthy Eating Index. Once the components and proportions of each ingredient were identified, the individual foods and actual serving sizes reported were assigned component scores. For example, in the case of spaghetti and meat sauce, the amount of pasta in the serving was assigned to the grains category, the proportion of meat in the meat sauce was assigned to the meat and beans category and the tomato and other vegetables in the sauce were assigned to the vegetable category. For some pre-packaged foods, a recipe was not available. In these cases, the same product was purchased. The purchased product was then separated into individual components (i.e. grains, meats etc). The components were then weighed and then converted to cup or oz equivalents per 1000 kcal of intake (Figure 3.1). This method was also used to test the accuracy of converting mixed foods into food group components from recipes.

Figure 3.1. Example of the weighing process for determining component foods in mixed dishes.



Once all of the components were calculated, they were summarized into an HEI-2005 score, which was then categorized into one of three different diet quality categories. Scores below 50 were categorized as “poor”; scores between 51 and 80 were categorized as “needs improvement” and scores above 80 were categorized as “good” (Kennedy et al. 1995). Diets that fell into the "poor" and "needs improvement" categories indicated that the individual was not in compliance with the Dietary Guidelines for Americans (Guenther et al. 2007).

Patterns of food consumption

Food types and patterns of food consumption were assessed using food descriptions, meal locations and additional notes collected at the time of the dietary recalls. In addition, informal observations of the types of foods available, as well as popular foods in the community were collected during visits to local grocery stores, family style restaurants, fast-food outlets and convenience stores between 2007 and 2009. More formal observations of households included in the supplemental study as well as data collected during visits to 12 elementary schools during the same period also provided information on common foods and patterns for comparison to the recall data. The dietary recall notes, informal and formal observations were all used to provide contextual information about the types of foods consumed, meals served, location of meals and family eating patterns. A more detailed description of the dietary patterns among children in the Valley is provided elsewhere (see Chapter 4).

Data Analysis

All data were analyzed using Sigma Plot Version 11 (Systat Software Inc.) and SPSS Statistics (version 17). Descriptive statistics for anthropometric measures (height, weight, BMI, waist circumference), dietary intake values (kcals, fat, carbohydrates, protein) and Healthy Eating Index-2005 (HEI-2005) scores were reported as means and $\pm$ standard deviations. Mean dietary intakes were calculated for gender and age and then compared to Dietary Reference Intake values.

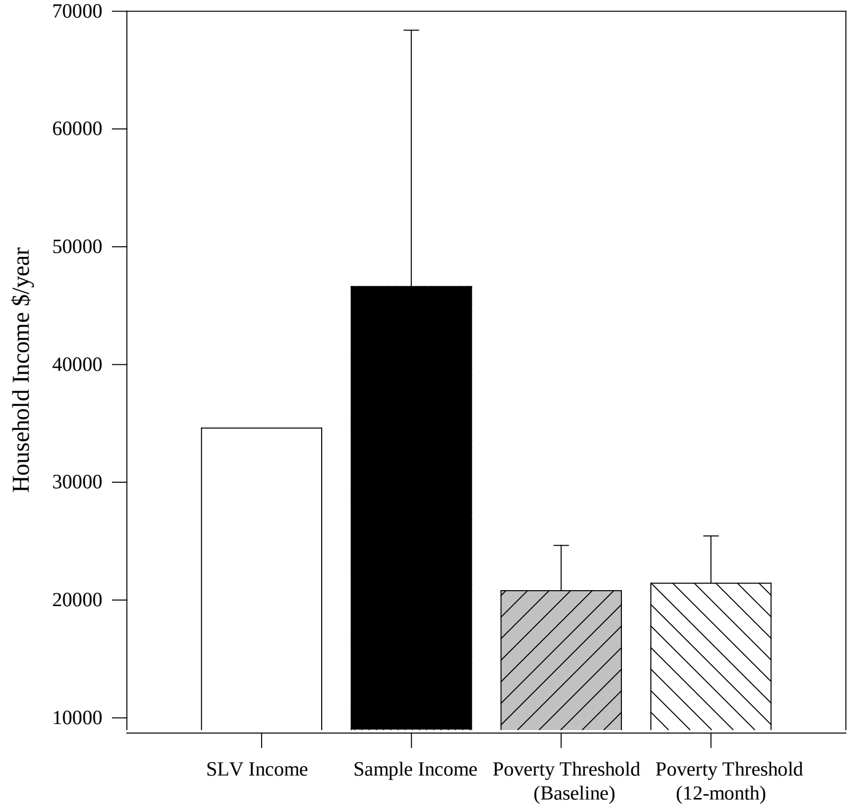
A *t*-test was used to test for gender differences in anthropometric measures, dietary intake values, total energy intakes and HEI-2005 scores. A paired t-test was used to test for changes in energy intake values and Healthy Eating Index between the baseline and 12-month measurement. A one way ANOVA was used to test the relationship between weight status, gender and intake values. Multiple linear models and Pearson correlation products were used to test the associations between diet quality, household income and BMI-for-Age percentiles. Regression models were used to test the relationship between diet quality, energy intake and number of foods consumed at school, home, restaurants and relative's homes. An alpha level of 0.05 was used for all statistical tests.

RESULTS

Sample

A total of 40 children (21 boys and 19 girls) between 7 and 12 years of age (9.7 $\pm$ 1.1 years) completed their baseline and 12-month clinic visits, and had at least one, 24-hour recall from each clinic visit. Based on income brackets, the median household income at both baseline and 12-months was $44,999, which was higher than the median poverty threshold incomes for baseline and 12-months ($20, 650 and 21, 200 respectively), as well as the most current median income for the San Luis Valley ($ 34,597) ($ (Figure 3.2).

Figure 3.2. Sample median income compared to SLV income and federal poverty thresholds, all children (n = 40)



When poverty status (above or below the threshold) was calculated for each individual, 31 (77.5%) of the children came from households which fell above the national poverty threshold and 9 (22.5%) came from households which fell below the national poverty threshold for the same year of their clinic visits; these proportions are similar to demographic data reported for the San Luis Valley (Colorado State Demography Office 2008). The mean income for households which fell above the national poverty level the mean household income was $56, 128 ± $14, 125. The mean income for households falling below the federal poverty threshold was $13, 889 ± $2,204

Anthropometric measures and weight status classification

Boys and girls were similar in age. Although girls tended to be shorter and weighed less than boys, there were no significant gender differences in anthropometric measurements at both the baseline and 12-month clinic visits (Table 3.4). As expected for normal growth, both boys and girls increased in height, weight, BMI and waist circumference (WC) (Table 34.)

Table 3.4. Anthropometric Measures at Baseline and 12-months

	Baseline Measurements				12-Month Measurements			
Measure	Boys (n = 21)	Girls (n = 19)	*p*	All Children (N = 40)	Boys (n = 21)	Girls (n = 19)	*p*	All Children (N = 40)
Age	9.7 + 1.2	9.7 + 1.2	*0.977*	9.7 + 1.2	10.8 ± 1.2	10.8 ± 1.2	*0.867*	10.8 ± 1.2
Height (cm)	139.2 ± 8.7	135.4 ± 7.8	*0.154*	137.4 ± 8.4	146.2 ± 9.2	142.6 ± 9.4	*0.239*	144.5 ± 9.4
Weight (kg)	41.3 ± 13	36.5 ± 13	*0.241*	39.0 ± 12.8	48.3 ± 15.3	42.1 ± 14.0	*0.194*	45.4 ± 14.8
BMI (kg/m^2)	21.0 ± 5.0	20.0 ± 5.3	*0.397*	20.3 ± 5.1	22.3 ± 5.6	20.4 ± 5.5	*0.282*	21.4 ± 5.6
WC (cm)	63.7± 13.2	60.8 ± 13.2	*0.490*	62.4 ± 13.1	67.0 + 15	63.0 ± 13	*0.362*	64.7 ± 13.8

When weight status was classified by age and gender specific BMI-for-Age percentiles, almost half of the children were classified as overweight or obese at both baseline and 12-months (Table 3.5). At baseline and 12-months, there were more overweight/obese boys than girls, but the difference was not significant (Table 3.5).

Table 3.5. Weight status at baseline and 12-months

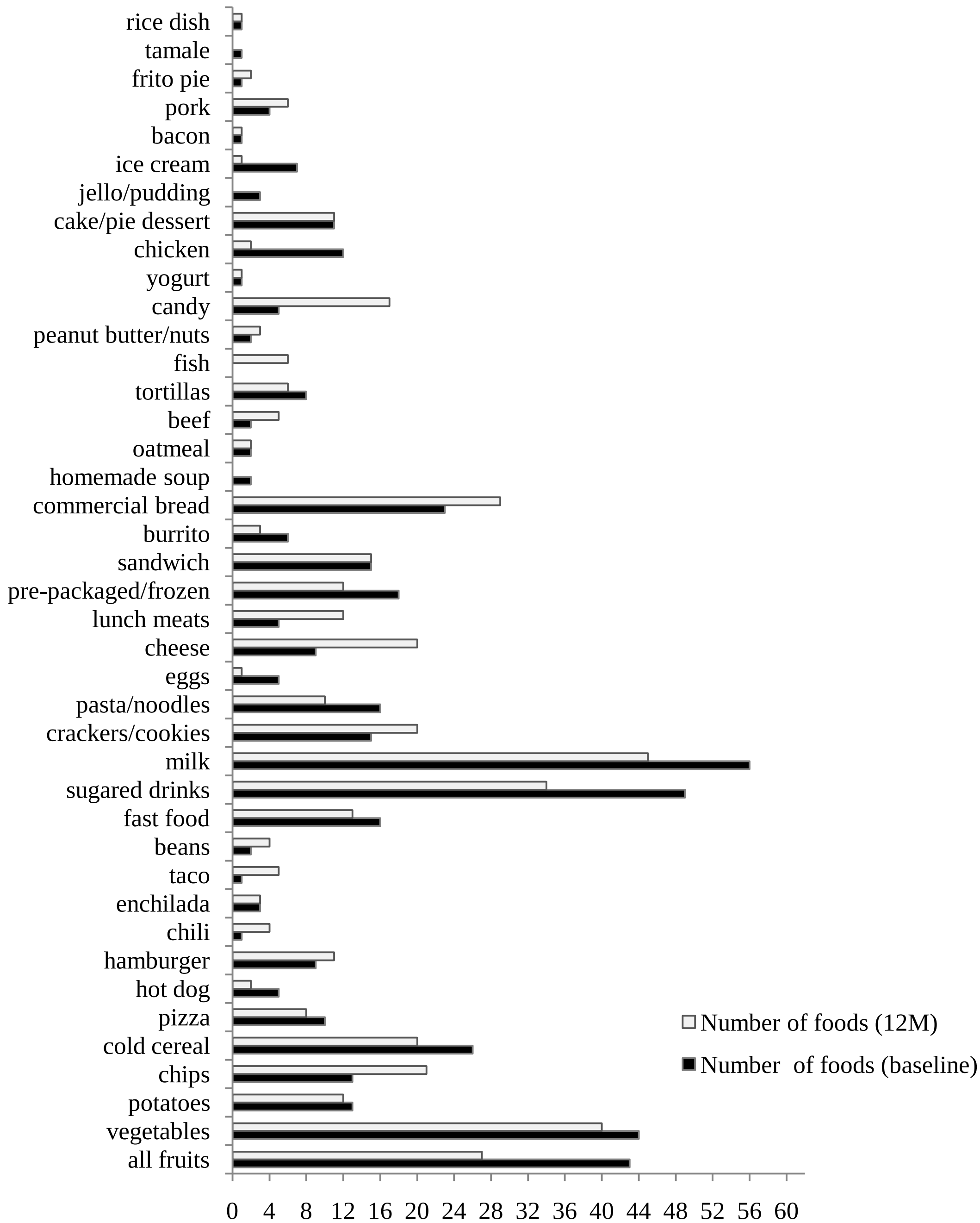
		Baseline Weight Status				12-Month Weight Status			
Weight Status		Boys	Girls	*p*	All Children	Boys	Girls	*p*	All Children
Normal Weight	N	9	12		21	8	13		21 52.5%
	%	22.5%	32.5%		52.5%	20%	32.5%		
Overweight/Obese	N	12	7		19	13	6		19 47.5%
	%	30.0%	17.5%		47.5%	32.5%	15%		
				0.199				*0.06**	
Total	N	21	19		40	21	19		40 100%
Percent of total	%	52.5%	47.5%		100%	52.5%	47.5%		

*Reaching a significant difference between boys and girls at 12-months; $\chi^2 = 3.68$

Common foods reported

At both baseline and 12-months children reported foods that could be classified into 41 different categories (Figure 3.3). A more detailed description of these food types can be found in Chapter 4.

Figure 3.3. Categories and numbers of foods reported at baseline and 12-months.



The most common types of foods reported included fruits, vegetables, cold cereal, sweetened beverages (inlduding sodas, sports drinks, and other non-carbonated sweetened drinks), milk and commercially processed breads. Fish, eggs, and bacon were some of the least common foods reported.

Dietary Intake

At baseline, boys tended to have higher total energy intakes than girls; however, the difference was not significant. Likewise, at 12-months, boys tended to have higher total intakes than girls, but again, the difference between groups was not significant (Table 3.6). For the entire group (N = 40), intakes were slightly higher at 12-months than intakes reported at the baseline measurement; however this change was not significant, and supports the first hypothesis (Table 3.6).

Table 3.6. Reported total dietary intake values for Baseline and 12-months

Measure	Baseline Measurements: Boys (n = 21)	Baseline Measurements: Girls (n = 19)	Baseline Measurements: *p*	Baseline Measurements: All Children (N = 40)	12-Month Measurements: Boys (n = 21)	12-Month Measurements: Girls (n = 19)	12-Month Measurements: *p*	12-Month Measurements: All Children (N = 40)	p^*
Total kcal	1776 ± 615	1522 ± 503	*0.164*	1655 ± 572	1705 ± 706	1483 ± 718	*0.330*	1600 ± 711	*0.702*
Carbohydrate(g)	240 ± 97.6	203 ± 71.7	*0.183*	223 ± 87	232 ± 110	197 ± 124	*0.350*	215 ± 117	*0.760*
Protein (g)	62.6 ± 27.3	55.4 ± 27.2	*0.414*	59 ± 27	58.5 ±21.6	53.7 ± 19.4	*0.471*	56 ± 20.5	*0.582*
Fat (g)	65.2± 27.7	57.1 ± 23.3	*0.325*	61 ± 26	63.7 + 35.7	55.2 ± 25.6	*0.397*	60 ± 31	*0.785*

*Changes in intakes among the entire group from baseline to 12-months

Relationship between reported intakes, weight status, and gender

There was no relationship between weight status and reported energy intake at either baseline or 12-months. Likewise, there was no relationship between reported carbohydrate, protein and fat intake and weight status. Normal weight and overweight/obese children reported similar energy, carbohydrate, protein and fat intakes. Among both groups, there tended to be a decrease in reported kilocalories, protein and fat from the baseline to 12-months recall.

Table 3.7. Reported baseline and 12-month intakes by gender and weight status

	Baseline Measurements					12-month Measurements				
	Normal weight		Overweight/Obese			Normal weight		Overweight/Obese		
Measure	Boys (n = 9)	Girls (n = 12)	Boys (n =12)	Girls (n = 7)	*p*	Boys (n = 8)	Girls (n = 13)	Boys (n =13)	Girls (n = 6)	*p*
kcal	1790 ± 566	1505 ± 417	1765 ± 417	1550 + 662	*0.751*	1741 ± 730	1466 ± 626	1683 ± 720	1520 ± 955	*0.790*
Carbohydrate(g)	235 ± 97	197 ± 30	244 ± 102	214 ± 116	*0.486*	240 ± 101	189 ± 116	119 ± 674	215 ± 151	*0.692*
Protein (g)	65 ± 33	59 ± 27	61 ± 24	56 ± 20	*0.992*	64 ± 26	57 ± 19	55 ± 19	46 ± 21	*0.257*
Fat (g)	67 ± 29	59 ± 26	64 ± 28	55 ± 20	*0.810*	62 ± 41	55 ± 21	65 ± 34	55 ± 36	*0.678*

There were no differences in absolute reported intake between overweight and normal weight children. However, when intake values were converted to intake per kilogram of body weight, there was an association between intake and weight status. At both baseline and 12-months, overweight weight boys and girls both reported significantly lower kilocalories per kilogram (kcal/kg) of body weight than normal weight boys and girls (Table 3.8). Likewise, overweight boys and girls reported significantly lower fat intakes per kilogram at both baseline and 12-months (Table 3.8). At 12-months, overweight/obese boys and girls reported significantly lower protein intakes than normal weight boys and girls (Table 3.8).

Table 3.8. Reported baseline and 12-month intakes per kilogram of body weight, by weight status and gender.

Baseline Measurements						12-month Measurements				
Normal weight			Overweight/Obese			Normal weight		Overweight/Obese		
Intake	Boys (n = 9)	Girls (n = 12)	Boys (n =12)	Girls (n = 7)	*p*	Boys (n = 8)	Girls (n = 13)	Boys (n =13)	Girls (n = 6)	*p*
kcal/kg	72 ± 31	65 ± 27	35.8 ± 13	35 ± 13	*0.001*	54 ± 19	61 ± 21	29.8 ± 9.4	33.1 ± 14	*0.000*
CHO/kg*	7.7 ± 3.4	7.0 ± 1.9	5.1 ± 2.0	4.9 ± 3.4	*0.059*	7 ± 2.9	5.8 ± 4.0	4.1 ± 2.1	3.5 ± 2.2	*0.088*
Protein/kg	2.1 ± 1.2	1.8 ± 0.8	1.3 ± 0.3	1.2 ± 0.6	*0.065*	1.8 ± 0.6	1.7 ± 19	1.0 ± 0.3	0.8 ± 0.2	*<0.01*
Fat/kg	2.1 ± 0.8	2.0 ± 0.7	1.3 ± 0.6	1.2 ± 0.6	*0.015*	1.7 ± 0.9	1.6 ± 0.6	1.1 ± 0.5	0.9 ± 0.5	*0.051*

**Carbohydrate intake/kg body weight*

Group intake comparison to Estimated Energy Requirements

Age and gender specific Estimated Energy Requirements (EERs) and Dietary Reference Intake recommended (DRI) intakes for carbohydrates and protein were calculated for each child. At both baseline and 12-months, children's reported energy intakes were lower than their estimated energy requirements (Table 3.9). However, at both baseline and 12-months, reported carbohydrate intakes were higher than recommendations (Table 3.9). On the other hand, reported protein intakes were similar to recommendations for protein intakes (Table 3.9). Finally, at both baseline and 12-months, reported fat intakes fell into the recommended range for percentage fat (Table 3.9). These results do not support H_3: Children's intakes will be higher than their age and gender specific recommendations.

Table 3.9. Estimated Energy Requirements (EERs) and reported intakes for baseline and 12-months.

Measure	Baseline Intakes EER/DRI (N = 40)	Baseline Intakes Actual Intake (N =40)	*P*	12-Month Intakes EER/DRI (N = 40)	12-Month Intakes Actual Intake (N = 40)	*P*
kcal	1695 ± 390	1655 ± 572	*0.047*	1829 ± 423	1600 ± 711	*0.047*
Carbohydrate (g)	100 ± 0.0	223 ± 87	*0.000*	100 ± 0.0	215 ± 117	*0.000*
Protein (g)	51 ± 17	59 ± 27	*0.419*	60 ± 19	56 ± 20	*0.419*
Fat (% of kcal)	25-35%	33% ± 8.3%	*0.101*	25-35%	34% ± 9.1%	*0.101*

Diet Quality and changes in Diet Quality as assessed by HEI-2005 scores (Healthy Eating Index-2005)

There were no significant increases or decreases in Healthy Eating Index scores from baseline to 12-months (Figure 3.4, Table 3.10). At baseline, HEI-2005 scores fell between 23 and 73.6 (mean score 47.7 ± 10.5). At 12-months, the scores fell between 23.6 and 67.1 (mean score 45.2 ± 10.3).

Figure 3.4. Comparison of Baseline and 12-Month HEI-2005 scores, all children (n =40

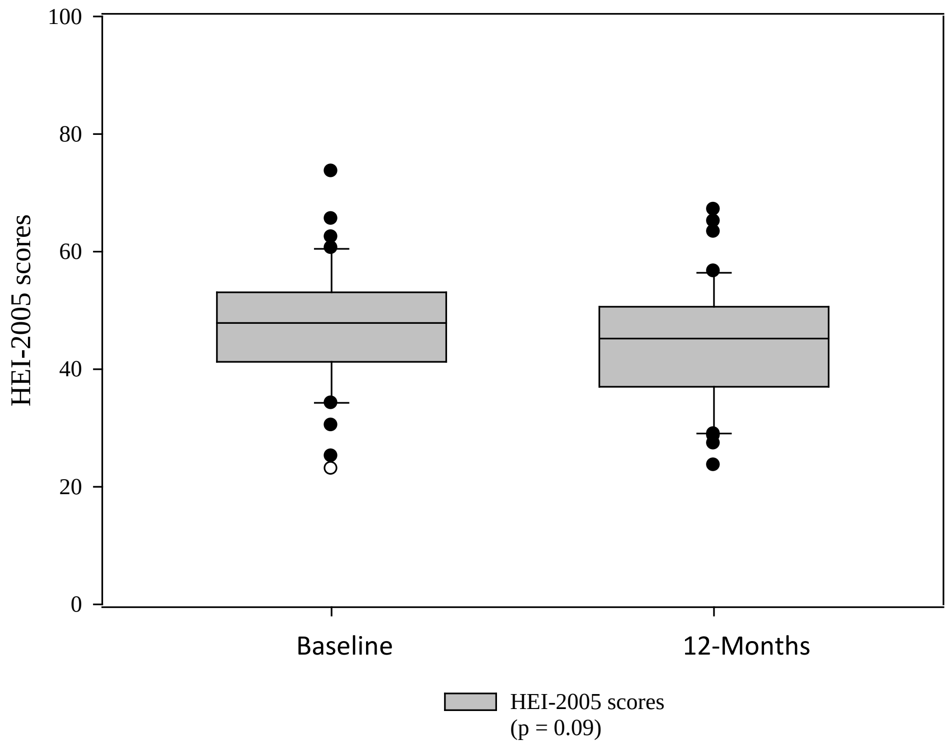


Table 3.10. Baseline and 12-month HEI-2005 scores, all children (n = 40).

	Baseline	12-Month	*p*
Mean HEI-score	47.4 ± 10.5	44.3 ± 10.3	*0.185*
Minimum Score	23.0	23.6	
Maximum Score	73.6	67.1	

When individual HEI-scores were grouped into Kennedy et al.'s (1995) diet quality categories ("poor", "needs improvement", "good"), the majority of scores fell below 50, or into the "poor" category, implying a low quality diet at both baseline and 12-months. There were no scores above 80; and none of the scores could be placed into the "good" category; implying that all children in this sample have a low quality diet with regard to the Dietary Guidelines for Americans. At baseline, 67.5% had HEI-2005 scores which implied a "poor" diet and 32.5% had scores which implied a diet which "needs improvement" (Table 3.11). Likewise, at 12-months, 77.5% of the children had scores which implied a "poor" diet and 22.5% scores which implied a diet that "needs improvement" (Table 3.11).

Table 3.11. Baseline and 12-month diet quality categories, all children.

Diet Quality Category[a]	Baseline		12-months	
Poor (HEI score below 50)	n = 27	67.5%	n =31	77.5%
Needs Improvement (HEI score 50-80)	n = 13	32.5%	n = 9	22.5%
Good (HEI score above 80)	n = 0	0%	n = 0	0%
TOTAL	N = 40	100%	N = 40	100%

[a] after Kennedy et al. (1995)

Because all children fell into the "poor" or "needs improvement" categories, further within group comparisons for diet quality were based on HEI-scores rather than diet quality categories.

Gender, Household income and HEI-2005 scores

There was no relationship between gender and HEI-2005 scores at either baseline or 12-months. Likewise, there was no relationship between reported household income and HEI-2005 scores at baseline or 12-months (Figure 3.5 and Figure 3.6).

Figure 3.5. Gender, household income and HEI-2005 scores at baseline, all children (n = 40)

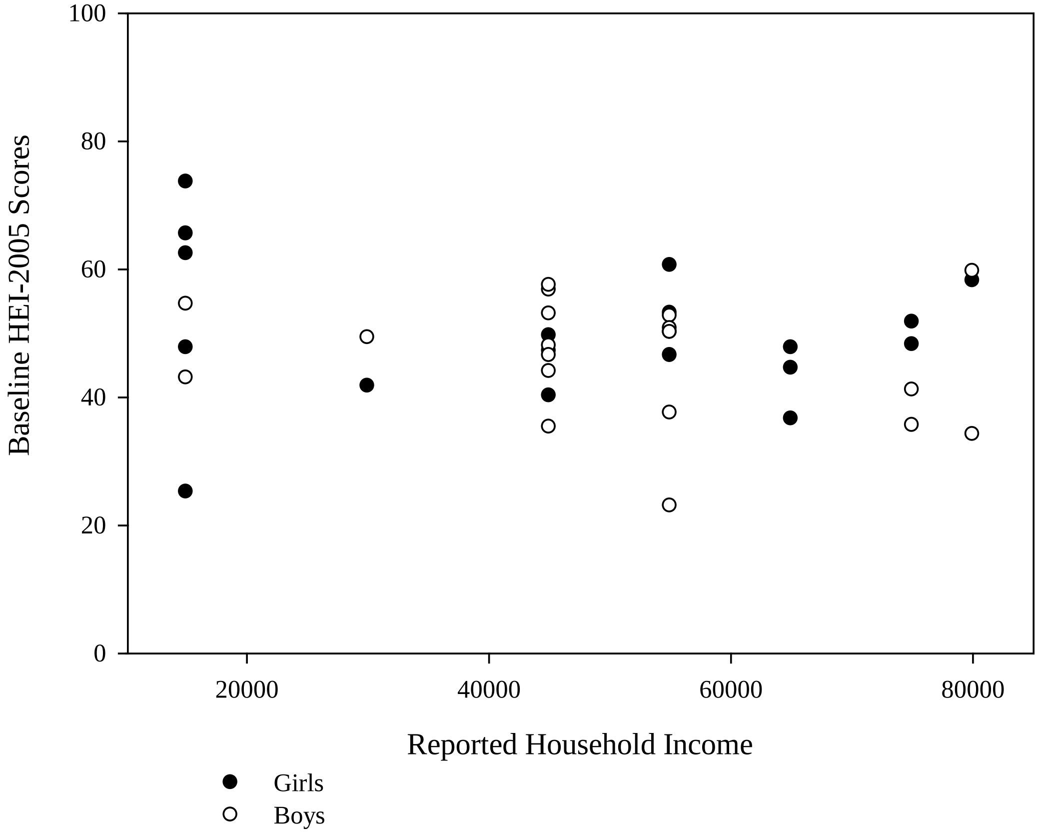
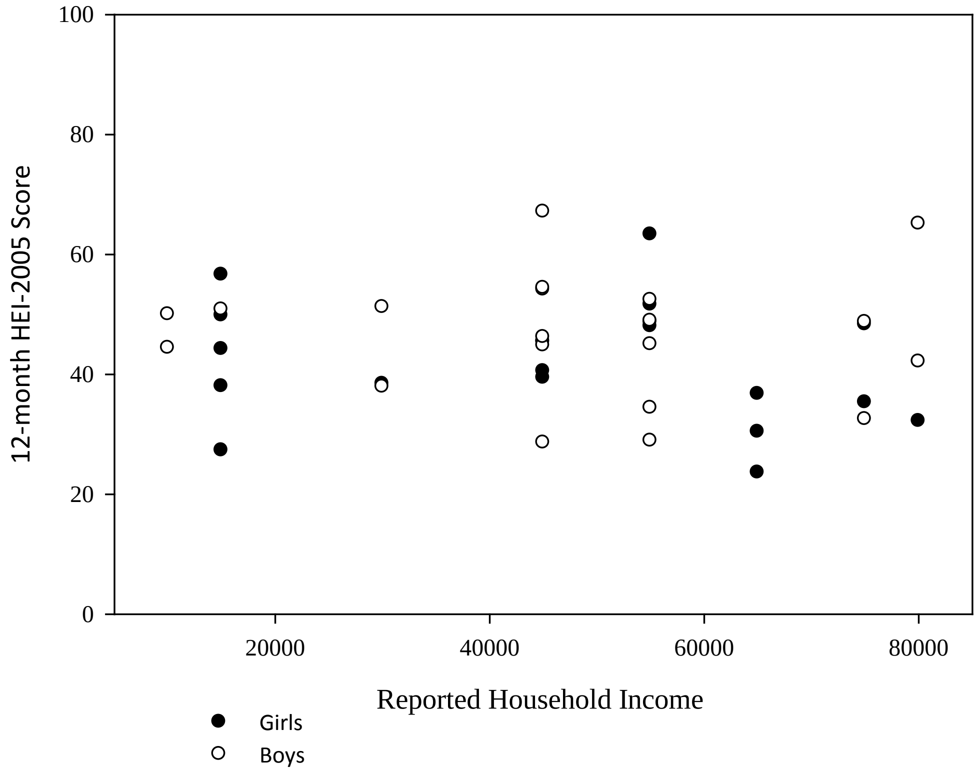


Figure 3.6. Gender, household income and HEI-2005 scores at 12-months, all children (n = 40)



Age and gender specific BMI-for-Age percentiles and HEI-2005 scores

At both baseline and 12-months, the majority of the sample fell above the 75th BMI-for-Age percentile (majority between 80th -99th percentiles) and had HEI scores that fell between 50 and 60 (Figures 3.7 and 3.8). However, there was no relationship between HEI-2005 scores and BMI-for-Age percentiles at either baseline or 12- months (Figure 3.7 and Figure 3.8). These results do not support H_2: Children with a higher BMI-for-Age percentile will have a higher HEI-2005 score than children who fall into lower BMI-for-Age percentiles.

Figure 3.7. Relationship between baseline BMI-for-Age percentile and HEI-2005 scores, all children (N = 40)

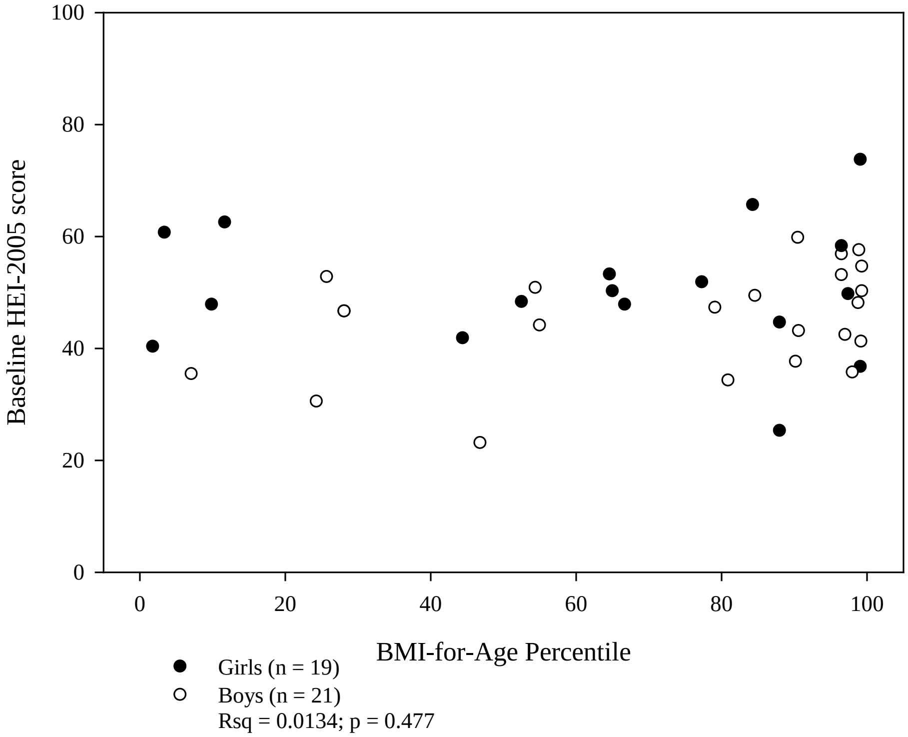
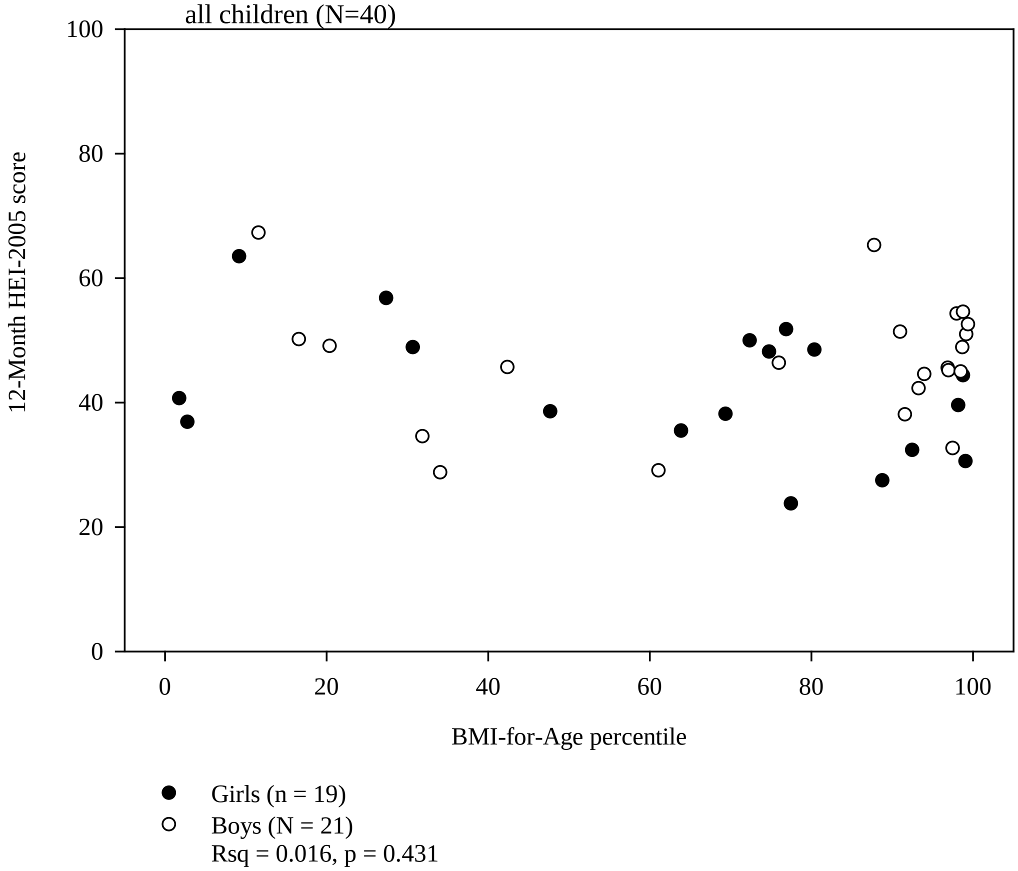


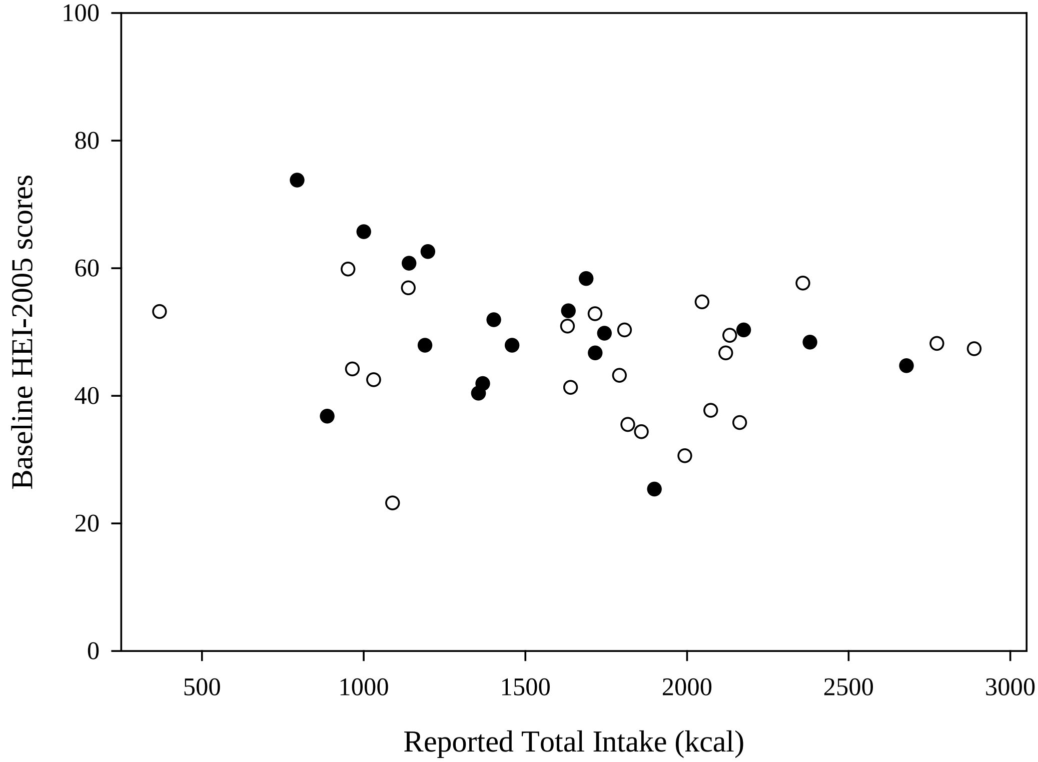
Figure 3.8. Relationship between 12-month BMI-for-Age percentiles and HEI-2005 scores, all children (N=40)



Total Intake and HEI-2005 scores

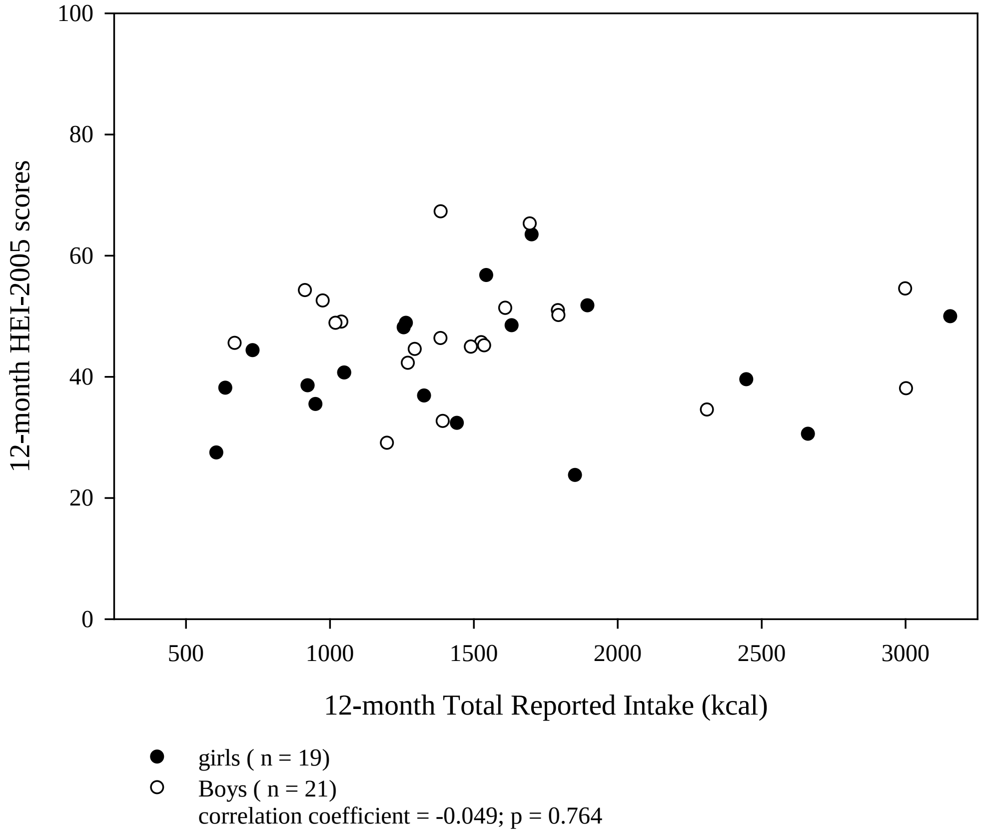
There was no correlation between total reported intake (kilocalories) and HEI-scores at either baseline or 12-months (Figures 3.9 and 3.10). These results do not support the hypothesis H_5: There will be a positive correlation between total reported intake and HEI-2005 scores at both baseline and 12-months.

Figure 3.9. Relationship between baseline HEI-2005 scores and total reported intake, all children (N=40)



● Girls (n = 19)
○ Boys (n =21)
Correlation coefficient = -0.103; p = 0.528

Figure 3.10. Relationship between total reported intake and HEI-2005 scores at 12-months, all children (N= 40)



Relationship between diet quality and the number of foods consumed at school

At baseline, there was no relationship between the number of individual foods consumed at school and HEI-2005 scores (Figure 3.11). Similarly, at 12-months there was no relationship between number of foods at school and HEI-score (Figure 3.12). These results do not support the hypothesis H_4: Children who consume a higher number of foods from school will have a higher quality diet than children who consume a lower number of foods from school.

Figure 3.11. Relationship between the number of foods consumed from school and baseline H EI-2005 score, all children (N = 40)

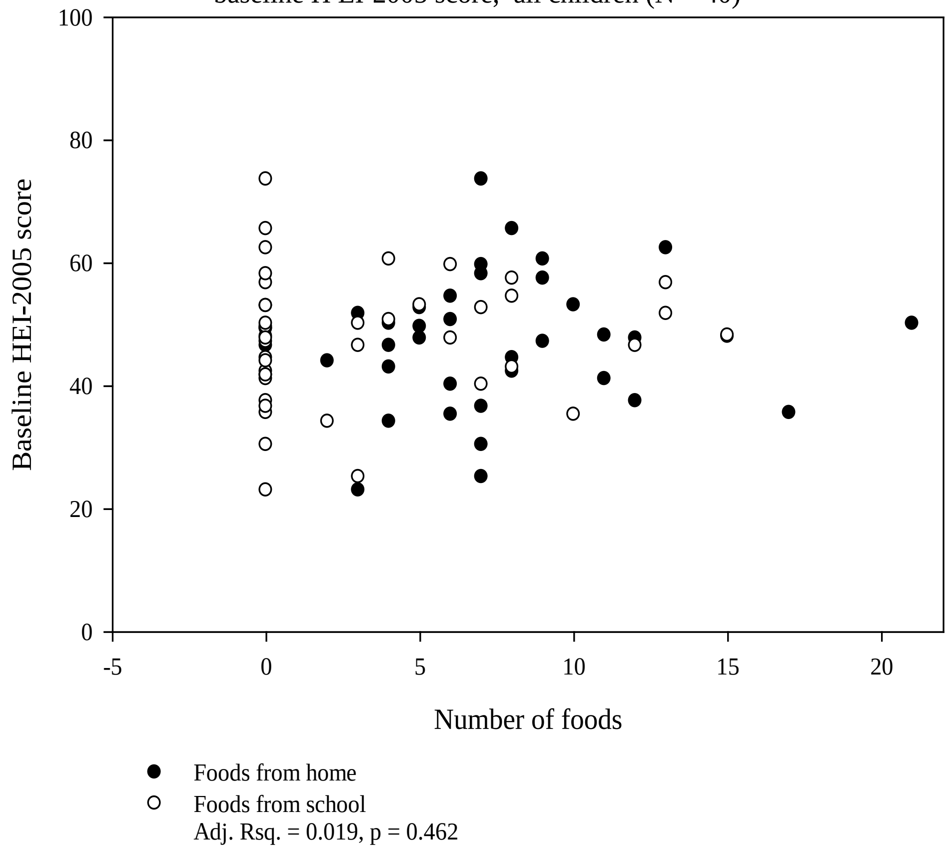
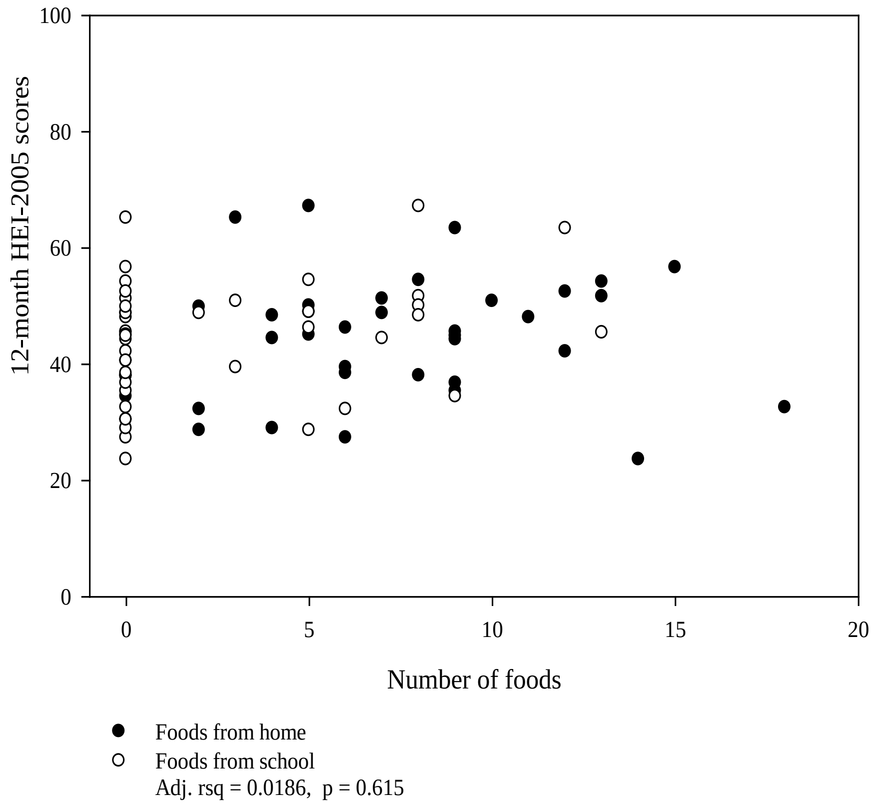


Figure 3.12. Relationship between number of foods from school and 12-month HEI-2005 score, all children (n = 40)



HEI-2005 food component scores

The highest scoring components (i.e. compliant with dietary guidelines) at both baseline and 12-months were the Meat and Bean and SoFAAS (discretionary calories: solid fats, alcohol and added sugars) components (Table 3.12). Intakes for these components received a score that was at least 50% of the maximum score possible. All of the other component scores fell below 50% of the maximum score at both baseline and 12-months, or at 12-months. The component scores for total fruit and oils increased from baseline to 12-months. However, with the exception of these two components, there were no significant changes in individual food component scores from baseline to 12-months (Table 3.12).

Table 3.12. Baseline and 12 month HEI-2005 food component scores, all children (N = 40).

Component Group	Maximum Score possible	Baseline Score	12-month Score	*p*
Total Fruit	5	0.322 ± 1.0	1.44 ± 1.5	*<0.001*
Whole Fruit	5	1.6 ± 2.1	0.91 ± 1.8	*0.102*
Total Vegetables	5	1.9 ± 1.7	1.4 ± 1.5	*0.260*
Dark Green and Orange vegetables	5	0.25 ± 0.99	0 ± 0	*0.114*
Total Grains	5	4.3 ± 1.2	4.1 ± 1.5	*0.649*
Whole Grains	5	0.25 ± 1.1	0.37 ± 1.3	*0.590*
Milk	10	5.2 ± 3.8	4.9 ± 3.7	*0.659*
Meat and Beans	10	7.4 ± 3.4	7.4 ± 3.5	*0.997*
Oils	10	0 ± 0	0.91 ± 2.3	*0.016*
Saturated Fat	10	5.1 ± 3.7	4.5 ± 3.8	*0.449*
Sodium	10	3.5 ± 3.1	2.6 ± 2.7	*0.165*
Calories from SoFAAS	20	17.4 ± 4.5	15.9 ± 5.7	*0.202*

In addition to the low overall HEI-2005 scores, the baseline and 12-month individual component scores were lower than component scores from a national (NHANES, n = 900) sample of children within the same age range. The only exceptions were the scores for SoFAAS (discretionary calories: solid fats, added sugars and alcohol) component, indicating better compliance with guidelines for solid fat and added sugar intakes. At both baseline and 12-months, these scores were higher than the NHANES sample.

Impact of intervention status on diet quality

Two-thirds (n = 25) of the children in this sample were from families randomized into the intervention group which received home-based life style coaching. Both groups were similar in body weight at 12-months, and there was no difference in BMI-for-Age percentiles between the two groups ($p = 0.955$). When energy intake and diet quality were compared, there were no significant differences between the two groups. However, at the 12-month recall (after the coaching was completed) children from families who received coaching tended to have slightly lower HEI-2005 scores and higher energy intakes than the non-randomized group (Table 3.13).

Table 3.13. Energy Inake and HEI-2005 scores by intervention status, experimental vs. control group children.

	Intervention (received coaching)	Non-intervention (usual care)	*p*
N	25	15	
Energy Intake (kcal)	1621 ± 706	1483 ± 687	0.549
HEI-2005 score	43 ± 10	46 ± 10.1	0.412

DISCUSSION

In this study, almost half of the children were classified as overweight or obese by BMI-for-Age percentiles. This is higher than the percentage of overweight and obese children in the state (25%), as well as the rate for children living in rural Colorado (32%) (Colorado Department of Public Health and Environment 2008). Furthermore, the mean BMI (kg/m^2) for children in this study was higher than those previously reported in older longitudinal studies of dietary intake among US children of similar age (Berkey et al. 2000).

There were no gender differences in BMI-for-Age percentiles and weight status categories. The proportion of overweight and obese children in the sample did not change from the baseline measurement to the 12-month measurement. Similarly, there were no longitudinal changes in reported intake and diet quality (as assessed by Healthy Eating Index-2005). These results supported the first hypothesis tested; H_1: There will be no change in reported intakes between from baseline to 12-months. As such, the results suggest that a 12-month period may not be long enough to see any significant changes in diet.

At both the baseline and 12-month dietary recall interviews, all children, regardless of weight status, reported total energy intakes that that were significantly lower than their Estimated Energy Requirement (EER). These results do not support the second hypothesis tested, H_2:

Children's reported intakes will be higher than their Estimated Energy Requirements. These results also differ from the 2004-2005 School Nutrition Dietary Assessment Study. In this study, 24-hour recall data were collected from a random sample of 732 US elementary school children. Children in this sample reported intakes that were higher than their Estimated Energy Requirements (EER) (Clark et al. 2009). In addition, the mean energy intakes in this sample were lower than energy intakes from recall data reported for children of similar ages in the United States, Canada, and Crete (Berkey 2000; Galloway 2007; Angelopoulos et al. 2009). Likewise, the children's intakes were lower than those reported from Food Frequency Questionnaires of 472 children participating in a longitudinal cardiovascular disease study (Project HeartBeat!) in Texas (Fulton et al. 2009).

The lower intakes reported by children in this sample suggest that children in the Valley have lower intakes than other children in the United States. The lower energy intakes may also be a reflection of a small biased sample. The data reported here was collected from 40 children participating in an intervention study, and was collected from a small population in a single region of the United States. On the other hand, in previously mentioned studies (Clark et al. 2009; Berkey et al. 2000), the sample sizes were well over 200 children, were random samples collected from several regions in the United States. The effect of a small sample size in this study is reflected by the low statistical power in some of the data analyses. For example, when energy intakes were compared within the group as well as to Estimated Energy Requirements, the power fell well below the desired power of 0.800 (power = 0.050).

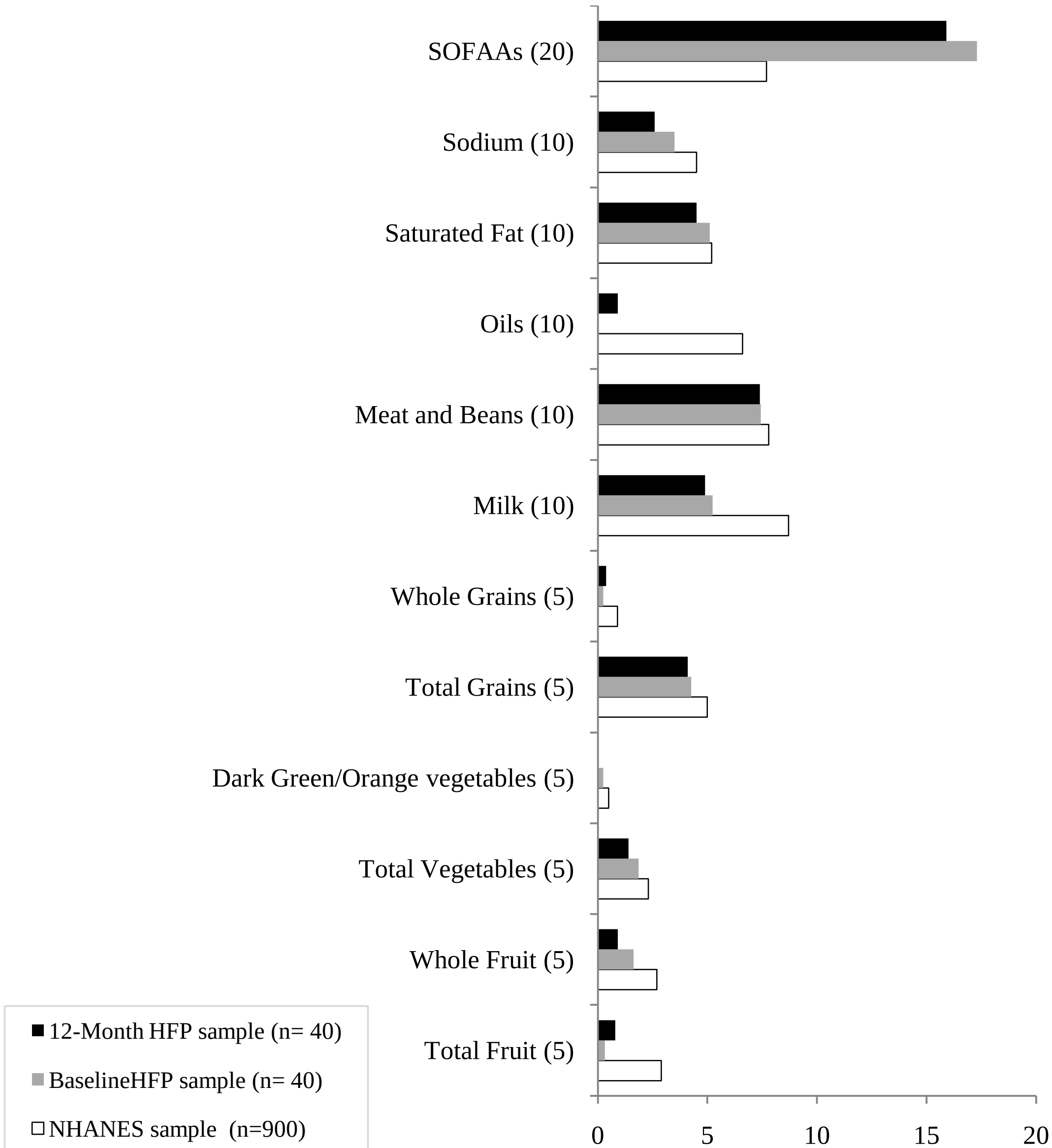
Despite the small sample, and the low statistical power of the energy intake analyses, observations in the community, households and schools as well as notes collected during the recall interviews suggest that children in the Valley may have relatively lower intakes, and these intakes may reflect parental or familial beliefs about eating, overeating and snacking. In two cases, children reported that they did not have snacks at home because their parents did not allow snacking in between meals. In addition, during observations at home with some of the children, it was noted that snacking was not common in the households, even among parents, extended family or older or younger siblings. In one family, where snacking between meals was observed, children did not have free access to snacks. Rather, the snack was served to the child by the parent. The observations and informal interviews with the children and parents in the Healthy Family Project suggest that energy intakes may be lower due to reduced snacking in between meals.

On the other hand, lower reported energy intakes may also reflect underreporting. While previous studies have reported on the accuracy of elementary school children's ability to recall meals (Lytle et al. 1993; Dommel Baxter et al. 2006) they also report cases of underreporting during recalls; therefore, it also possible that children in this sample were underreporting their intakes. Previous studies suggest a link between increased BMI and underreporting (Briefel et al. 1997; Domel-Baxter et al. 2006). Among adults, overweight women are more likely to underreport their intakes (Briefel et al. 1997). Similarly, overweight children were found to be less accurate in their intake reporting after several trials (Domel-Baxter et al. 2006). Among the children in this sample there was a tendency for BMI (kg/m^2) percentiles to be skewed towards the higher end of the percentile range, and over half of the sample was classified as overweight or obese. Given these results and those of previous studies, it is possible that the results reflect a higher prevalence of underreporting among the children. While there was no association between weight status and absolute reported energy intake, there was an association between weight status and energy intake per kilogram of body weight. In this sample, overweight and obese girls had significantly lower energy intakes per kilogram of body weight as well as carbohydrate intakes per kilogram of body weight, suggesting some reporting bias associated with weight status. Furthermore, the children in this sample were participants in an intervention study which involved three clinic visits with dietary interviews and weight measurements. It is possible that knowing that they were part of a study which is interested in weight management, healthy eating and physical activity influenced children's reporting behaviors. Likewise, it is also possible that children and perhaps parents adjusted their eating the day before their scheduled recall, resulting in lower intakes. Given all of the possible explanations for the relatively low energy intakes in this study, it is likely that the energy intake values observed in the data analyses resulted from a combination of the lack of snacking between meals, underreporting and potential behavioral adjustments before the clinic visit.

In addition to low energy intakes, children in this sample had low Healthy Eating Index-2005 (HEI-2005) scores. There are three diet quality categories (Kennedy 1995) based on the Healthy Eating Index; "poor", "needs improvement" and "good". The scores in this sample only fell into two categories: "poor" and "needs improvement", with the majority of scores falling into the "poor" diet quality category. These results suggest that children in this sample were not meeting the Dietary Guidelines for Americans. Likewise, the mean overall HEI-2005 scores for this sample were lower than Healthy Eating Index-2005 and for Healthy Eating Index (index prior to 2005) scores reported for other elementary school children in both in the United States as well as outside of the United States in Crete (Fingwe et al. 2009; Briefel et al. 2009; Feskanich 2004; Angelopoulos).

When individual HEI-2005 component scores were compared to the NHANES component scores, children in this sample scored lower on all components except for the SoFAAS component (solid fats, added sugars and alcohol) (Figure 3.13).

Figure 3.13. HEI-2005 component scores relative to NHANES HEI-2005 component scores



This suggests that compared to other children of the same age in the United States, children in this sample consume foods with fewer added sugars and solid fats. Interestingly, these results are similar to HEI-2005 scores reported for elderly adults living in rural communities (Savoca et al. 2009). In their study, Savoca et al. (2009) found that although the elderly rural adults had low overall HEI-2005 scores, they had relatively high component scores for SoFAAs, indicating lower consumption of added fat and sugars. The data from this sample and the results of the Savoca et al. (2009) study may reflect limited access to convenience stores or convenience foods in rural areas; thereby reducing the amount of added sugar and fats consumed. In addition, they may also reflect cultural views about sugary foods or convenience foods.

Although the data in this study conflict with data presented in a previous ethnographic study (Brett et al. 1999) which suggests high use of convenience foods among younger adults in the Valley; it may reflect views of elderly adults which were not captured in the earlier ethnographic interviews as well as families who live outside of Alamosa. Perhaps elderly adults, particularly those related to individuals in this study, see convenience foods as unacceptable or inaccessible; thereby reducing their consumption, as well as limiting access to their children or grandchildren. In this sample, some children reported eating with their grandparents, and at their grandparents' houses. While there were no direct associations between the locations of food consumption and diet quality, time spent with grandparents may ultimately influence the consumption of convenience foods over time. If the grandparents in the Valley had eating habits similar to those reported by Savoca et al. (2009), they may have provided foods lower in sugar and fat to their grandchildren, or limited the amount of convenience foods accessible to their grandchildren when they visited . Grandparents may have also influenced the types of foods served at home by helping their adult children with food purchases. The purchases that they provided to other family members may not have included convenience foods. This type of food sharing between family members was directly observed while spending time with families participating in the Healthy Family Project. For example, in the case of one family, a grandmother had purchased two boxes of oatmeal for her daughter to serve to her children. This oatmeal was served to the children at breakfast on two different days of observations.

In addition to familial influences on the consumption of added sugars and fats, the lower consumption of added sugars and solid fats in this study may also reflect school policies regarding vending machines, school snack bars, and milk consumption. These policies may have influenced greater milk consumption over sweetened beverages and snacks during the school day. At the time of the study, none of the elementary schools which the children attended had school snack bars or stores available to students. Only one school had a vending machine available, which was stocked with bottled water and low calorie or sugar-free sports drinks. In addition, all of the lunchrooms had a number of posters promoting milk consumption hanging in clear view of the students; and on more than one occasion lunchroom monitors were observed encouraging students to finish their milk cartons. For example, in one of the schools, the lunchroom monitor would check the students' milk cartons as they lined up to throw away their trays. Children who had not finished the milk in their carton, or those who had relatively full carton were sent back to their lunch table to finish the milk, or at least drink some of the milk. The high consumption of milk relative to sweetened beverages is further supported by the high frequency of milk reported in the recalls. At both baseline and 12-months, milk was the most frequently reported food type in the recalls (Figure 3.3).

Although diet quality of this sample differed from diet quality reported for other children, there were no significant within group differences in diet quality. For example, there was no association between HEI-2005 scores and BMI percentile. Nor, was there an association between intervention status (received coaching or not) and HEI-2005 scores at the 12-month visit. All children in the sample had low HEI-2005 scores, regardless of their BMI-for-Age percentile and intervention status. As a result, the second part of hypothesis H_2: Children with a higher BMI-for-Age percentile will have a higher HEI-2005 score than children with a lower BMI-for-Age percentile was rejected.

In a study of 522 elementary school children in Crete, Angelopoulos et al. (2009) found a positive association between energy intake and HEI-2005 scores. Among their sample, children who reported higher energy intakes had significantly higher Healthy Eating Index scores. However, among children in this sample, there was no association between energy intake and HEI-2005 scores at either baseline or 12-months. As a result, the hypothesis H_3: There will be a positive correlation between total reported intake and HEI-2005 scores was rejected. The difference between the results reported here and those reported by Angelopoulos et al. (2009), may be related to the low intakes reported by the Healthy Family Project participants. However, the results reported here may also reflect the effect of a small sample size, the power of the analysis fell below the desired power of 0.800 (power = 0.299). Perhaps a larger sample of children would have produced results similar to those reported by Angelopoulos et al. (2009).

Previous studies on the school environment and school food consumption (Briefel et al. 2009; Clark et al. 2009) suggest a link between the number of foods consumed at school and improved diet quality. In light of these previous findings, this study tested the relationship between diet quality and number of foods consumed at school. There was no relationship between the number of foods consumed at school and diet quality. Children, who consumed most of their foods at school, had HEI-2005 scores similar to those who consumed all of their foods at home. As a result, the hypotheses H_4: children who consume a higher number of foods from school will have a higher quality diet than children who consume a fewer number of foods from school was rejected.

The results reported here are different than those previously reported by Briefel et al. 2009 and Clark et al. 2009, who both found a positive association between diet quality and school food consumption. One potential explanation for this difference may again, be related to differences in sample size. Both Briefel et al. (2009) and Clark et al. (2009) used data collected from the 2004-2005 School Nutrition Dietary Assessment Study, which included a sample of 732 elementary school children from 287 schools across the United States. The sample in this study included only 40 children from 7 schools in the Valley. In a multiple linear model, the power was above the desired power of 0.800, both at baseline and 12-months (power = 0.812 and 0.802 respectively). Nevertheless, the sample may not be fully representative of all the children in the Valley, and perhaps, in a larger sample of children from all schools, the results may be similar to those reported by Briefel et al. (2009) and Clark et al. (2009).

On the other hand, because the some of the analyses had an acceptable statistical power (>0.800), the difference in results may also reflect school policies and/or dietary practices specific to the San Luis Valley, as well as other rural areas in the Western United States. As previously mentioned, children in this sample had lower added sugar and solid fat intakes (SoFAAS) than other US children; but had results similar to those reported for elderly rural adults. However, a previous study of rural Appalachian children reported high intakes of fats and added sugars, and attributed this to cultural dietary practices which included preferences for fried foods and sugared beverages (Crooks 2000). Perhaps the low sugar and added fat intakes reported here differ from those reported by Crooks (2000) because they reflect local food culture and school policy that is very different than those in rural communities in the eastern part of the United States. If this is the case, then it suggests that rural communities across the United States show a considerable amount of variation in both local food culture as well as local school policy. Therefore, the utilization of the term “rural” to identify all communities outside of metropolitan areas may not adequately reflect local variation in dietary practices, and could overlook potentially important behaviors or policies that are related to health outcomes.

Finally, median household income in this sample was higher than that for the San Luis Valley, and over 75% of the households were above the Federal Poverty Thresholds. There was no association between household income or poverty status and weight status. Nor, was there an association between household income and dietary intake. These results suggest that among this particular sample, children’s intake or weight status is not influenced by household income. Given the high household incomes relative to the rest of the Valley, the low reported energy intakes and the low incidence of snacking and sugary foods may reflect a biased sample which may not be fully representative of all the families living in the San Luis Valley. It is possible that the Healthy Family Project drew interest from families with relatively higher household incomes, who could, or were willing to invest more time into participation in a study. Likewise, children’s energy, added sugar and solid fat intakes may have been lower because they were from families who entered the study with a prior interest in healthy eating, weight management, and diabetes prevention. This interest may have influenced meal choices or patterns over the course of the study.

While this study provided some insight into the diets of children living in rural Colorado, it had some limitations. One limitation is the small sample size compared to previous which have examined dietary intake and quality among school children. This study had a very small sample size, resulting in a lower statistical power for some, but not all of the analyses. In addition, all of the children in the sample were from families participating in an intervention study, and although only 25 were part of the experimental group which received home-based lifestyle coaching, it is possible that just knowing they were part of a study resulted in the families altering their normal behaviors prior to clinic visits, or throughout the 12-month period that they were in the study. Likewise, the majority of children in the study came from two of the largest towns in the Valley; therefore, their reported intakes may not accurately reflect foods consumed by all children in the Valley; especially those from families who live in the smaller, outer towns of the Valley.

Despite these potential limitations, the dietary patterns observed in the data analysis were consistent with many of the informal observations collected by watching what types of foods were purchased in grocery stores as well as what children were eating at restaurants in the Valley. In addition, the types and amounts of school foods reported in the recall data were also similar to those observed during visits to 12 of the elementary schools in the Valley. As such, the recall data, while limited, was consistent with many of observations, thus the analysis did provide some insight into the dietary habits of rural school children. However, the sample size was small and primarily representative of two of the larger towns in the Valley. As a result, some of data were not able to accurately detect the potential variation in diets due to variation between the different towns in the Valley. Some of this variation included the size of the stores, number of restaurants, hours of operation and distance from homes to stores and restaurants. Therefore, a future direction that would improve on the sampling of this study and address the variation between towns would be to collect dietary recalls from a large sample of children living in each town within the Valley. For example, a sample of 40 children from each town would provide a sample of over 500 children, which would represent about a third of this children living in the Valley (Colorado State Demography Office 2008). A sample of this size would have excellent statistical power (1.00), would represent all of the towns in the Valley, and would be more comparable to the sample sizes in previous studies.

CONLCUSION

The results presented here indicate that children living in the San Luis Valley are not meeting recommendations for dietary intake or quality, but at the same time, have lower added sugar and fat intakes than other US children. In addition, the results suggest, no association between weight status and dietary intake or quality. Likewise, the results suggest that the number of foods consumed at school does not influence dietary intake or quality.

However, the results also indicate that almost half of the children in this sample are overweight or obese despite the lower energy, sugar and added fat intakes. Therefore, the results suggest that there may be other factors, beyond just dietary intake quality, that are contributing to the relatively high prevalence of obesity among children in this sample, and the San Luis Valley.

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CHAPTER IV

PATTERNS IN BEVERAGE CONSUMPTION AND RESTAURANT USE AMONG ELEMENTARY SCHOOL AGED CHILDREN IN THE SAN LUIS VALLEY, COLORADO

INTRODUCTION

Recent studies have reported significant changes in food consumption patterns over the past 20 years, and have linked some of these changes to excessive energy intake and obesity among children and adolescents (Nielsen et al. 2002; Popkin et al.; Crooks 2000; Johnson et al. 2001; Harnack et al. 1999). Food consumption patterns of concern include: increased frequency of snacking, increased consumption of sweetened beverages, increased consumption of energy dense snack foods, fast food type pizza and Mexican foods, and decreased milk consumption (Nielsen et al. 2002). In addition to changes in food consumption, Nielsen et al. (2000) attribute increases in energy intake in both adults and children to relative increases in the number of meals consumed away from home (i.e. consumed at restaurants and fast food establishments) and suggest a link between these changes and increases in obesity.

Previous ethnographic research in the town of Alamosa within the San Luis Valley, Colorado, also suggests that families with children rely more on convenience foods (frozen, pre-made, highly processed) as well as restaurant foods more commonly than meals at home (Brett et al. 2000). However, this research was conducted in 1999, and patterns of food consumption may have changed in the past 10 years. Furthermore, in this previous study, it was primarily adults who were interviewed; therefore, less is understood about the current patterns of food consumption among children in the San Luis Valley, Colorado.

The purpose of this study is to describe some of the dietary patterns and common types of foods consumed among elementary school children in the Valley. In addition, the association between two particular dietary habits (sweetened beverage consumption and eating at restaurants) on weight status were assessed. Two hypotheses were tested:

> H_1: At both baseline and 12-months, sweetened beverages will be the most frequent type of beverage reported, and milk will be the least frequent.
>
> H_2: Children with a higher percentage of eating occasions at restaurants will have higher BMI-for-Age percentile than children with a lower percentage of eating occasions at restaurants.

METHODS

Participants

Participants in the study were 40 children between 7 and 11 years of age (at baseline) from families participating in the San Luis Valley Healthy Family Project. Participants in the Healthy Family project were scheduled for 2 clinic visits (baseline, and 12 months) over a 12 month period. Both visits included a series of anthropometric measurements (height, weight, waist circumference and blood pressure), a 24-hour dietary recall and an interview which included questions about diet, physical activity, health care, and community resource use. In addition to the clinic visits, children from these families were invited to participate in a supplemental ethnographic study after they completed their 12-month clinic visit for the Healthy Family Project. The supplemental study involved a researcher spending the day with families and observing the children for 1 to 2 days. Children were observed from the time they awoke in the morning until the late evening; the total time for each day ranged between 10 and 12 hours. Five children agreed to participate in the supplemental ethnographic study.

Written informed consent was signed by all participating adults in the family, and assent forms were signed by all participating children. All research was approved by Colorado Multiple Institution Research Board.

Anthropometry

Height and weight measurements were collected during baseline, 6-month and 12-month clinic visits for the Healthy Family Project. Height was measured to the nearest 0.10 cm using an Accustat (Genentech Inc.) stadiometer. Weight was measured to the nearest 0.5 kilogram using a balance scale and waist circumference was measured to the nearest 0.10 cm with a measuring tape.

BMI was calculated as weight (kg) / height (m^2). Age and gender specific BMI-for-Age percentiles were calculated and summarized using the BMI calculator tool provided through the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention 2009). Weight status classification was also based on BMI-for-Age gender specific percentiles developed by the National Center for Health Statistics and Centers for Disease Control and Prevention (2000). Based on age and gender specific BMI-for-Age percentiles, children were classified as underweight, normal weight, overweight and obese following the more recent Centers for Disease Control and Prevention expert committee recommendations (Barlow et al. 2007) (Table 4.1).

Table 4.1. BMI-for-Age percentile based on weight status classification.

Percentile Range	Weight Status
Below 5^{th} percentile	Underweight
5^{th} – 84^{th} percentile	Normal weight
85^{th} – 94^{th} percentile	Overweight
95^{th} percentile or above	Obese

Dietary Intake and Food type Categories

Dietary intake was assessed using two 24-hour recalls; one collected at baseline and one collected at 12-months. As a part of their scheduled baseline and 12-month clinic visits, participating children completed a dietary recall interview with a trained data collector using The Nutrition Data System (University of Minnesota). Recalls were conducted during the week between Tuesday and Saturdays, with the exception of 4 individuals who completed their baseline interview on a Monday. Children were asked to return for a second follow up recall within a week of the first one. There were no significant differences in intake between the first and follow-up dietary recalls, and not all children in the sample completed all of the follow-up interviews. As a result, only the first baseline and first 12-month 24-hour recalls were used in this analysis.

At the beginning of each recall interview, children were asked if their intake on the previous day was usual, more than usual, or less than usual. During the recall, the interviewer also made notes when children talked about household rules on eating (i.e. snacking between meals), why (or why not) a child reported skipping breakfast or details about a particular meal or snack (e.g. cake at a birthday party, picnic at grandfather's ranch etc.)

The children were then asked to recall and describe all of the foods that they consumed from the time that they awakened in the morning to the time that they went to bed the night before. During the interviews, children were asked to provide detailed descriptions of the ingredients, preparation styles, portion sizes of foods and beverages, as well as the time and location of snacks or meals from the previous day. In order to obtain accurate portion size estimates, children were asked to use sample cups, plates, glassware, bowls and cutouts which had been marked with graduated measurements (example 8 oz, 4 oz, etc.) to describe the amounts.

Energy and macronutrient intakes were calculated from the recalls and compared to recommendations. Details on this analysis are discussed in detail elsewhere (see chapter 3). Following the macronutrient analysis, all of the foods reported in the recalls were grouped into food type categories. These categories were then used to determine the frequency of different foods reported by the children. In addition, categories of food were compared to the number of eating occasions (breakfast, lunch, dinner, and snack) and meal locations to determine where children were consuming most of their foods. The term "eating occasion" was used in place of meal, because in a number of cases, children reported meals as snacks. For example, five children reported their first meal of the day as a snack rather than breakfast. Because there were fewer details about the food cues that influenced their decision to call an eating occasion a snack or meal (see Wansink et al. 2004), all instances of eating were referred to as eating occasions.

Dietary Observations

In addition to the dietary recalls, information about food consumption patterns was collected during both formal and informal observations conducted in households, schools and the community. More formal dietary data were collected during direct observations of the supplemental study children (n=5) from the Healthy Family Project. Information about food consumption patterns during the school day was collected during school cafeteria observations and key informant interviews collected from 12 different elementary schools between 2007 and 2009. The information generated from all of these observations was used to provide contextual information about the foods reported in the dietary recalls. They also provided a means for comparing the patterns observed in the dietary recalls to patterns present in among other children in the Valley, as well as a rough measure of reporting accuracy. More specific details of these observations are described below.

As previously mentioned, Healthy Family Project children were invited to participate in a supplemental observational study following their 12-month clinic visit. Those who participated allowed a researcher visit the household and spend the entire observation day with the family (including: siblings, parents, extended family and family friends). Five children agreed to participate. On the scheduled observation days, the researcher arrived at the house when the children got up in the morning and remained there until right before they went to bed. During these observations, every eating occasion was recorded. For each eating occasion; the time, location, people present (parents, siblings, friends), food description, and amount of each food consumed were recorded. Notes from informal conversations with the families were also included, and provided additional context about the participants' views and beliefs concerning food preferences, diet, and food access in the community.

The school cafeteria observations were conducted as part of another study, the School Environment Project. However, they also provided an excellent opportunity to observe food consumption patterns in several different schools in the Valley. Between September 2007 and January 2009, 12 different schools were visited. Each school cafeteria was visited 4-6 times during each school year. During the visits, details about the lunchroom environment, such as, noise level, posters present, amount of time allotted for lunch, and types of foods being thrown in the trash were recorded. In addition to these observations, a lunch tray was purchased during some of the visits. The tray was photographed and types and amounts of foods as served were recorded. In addition to the lunchroom observations, food service staff were interviewed about the foods served. At five of the schools, two rounds (fall 2007 and fall 2008) of focus group interviews were conducted with 5th grade students. Part of these interviews included questions about food, school food policy, and perceived quality of the cafeteria food. In addition to the focus group interviews, key informant interviews were conducted with school administrators during one of the yearly visits to each school.

Finally, information about the relationship between community resources (stores, restaurants, food assistance programs) and diet was collected through informal observations made while the researcher lived in Alamosa between 2007 and 2009. During this time, local businesses (stores, restaurants) and food related community events (Farmer's Markets) were frequented. The types and costs of different foods were noted during visits to grocery stores and restaurants. The locations and types, as well as the local recommendations for restaurants, and restaurants and stores which were most often crowded were also noted. In addition, the researcher participated in community sponsored events and volunteered at the Alamosa Farmer's Market.

Data Analysis

Data were analyzed using Sigma Plot Version 11 (Systat Software Inc.) and SPSS Statistics (version 17). Descriptive statistics were used to describe the frequency of foods reported as well as number of meals and number of locations of meals. Chi-square analyses were used to determine the relationship between the frequency of foods consumed and location of meals; the frequency of food types and type of meal (snack, breakfast, lunch, and dinner) and the frequency of food types reported at baseline and 12-months. A correlation analysis and linear regression model were used to determine the relationship between meal type, meal location, food type and BMI-for-Age percentile.

RESULTS

Sample

A total of 40 children (21 boys and 19 girls) between 7 and 12 years of age (9.7 $\pm$ 1.1 years) completed at least their baseline and 12-month 24-hour recall and anthropometric measurements. Twenty-five of these children were from families randomized into the groups which received home based life style coaching as part of the Healthy Family Project. Five children (4 girls and 1 boy) from the sample of 40, completed at least 1 full day of observations for the supplemental study following their 12 month clinic visit.

Anthropometric measures and weight status classification

Boys and girls were similar in age and anthropometric measurements at both the baseline and 12-month clinic visits (Table 4.2). As expected for normal growth, both boys and girls increased in height, weight and BMI (kg/m^2) between baseline and 12-months. When weight status was classified by age and gender specific BMI-for-Age percentiles, almost half of the children were classified as overweight or obese at both baseline and 12-months. Although not statistically significant, when weight status was compared within gender, there was a higher percentage of boys that were overweight and obese than girls (Table 4.3).

Table 4.2. Anthropometric measures at baseline and 12-months.

	Baseline Measurements				12-Month Measurements			
Measure	Boys (n = 21)	Girls (n = 19)	*p*	All Children (N = 40)	Boys (n = 21)	Girls (n = 19)	*p*	All Children (N = 40)
Age	9.7 + 1.2	9.7 + 1.2	*0.977*	9.7 + 1.2	10.8 ± 1.2	10.8 ± 1.2	*0.867*	10.8 ± 1.2
Height (cm)	139.2 ± 8.7	135.4 ± 7.8	*0.154*	137.4 ± 8.4	146.2 ± 9.2	142.6 ± 9.4	*0.239*	144.5 ± 9.4
Weight (kg)	41.3 ± 13	36.5 ± 13	*0.241*	39.0 ± 12.8	48.3 ± 15.3	42.1 ± 14.0	*0.194*	45.4 ± 14.8
BMI (kg/m^2)	21.0 ± 5.0	20.0 ± 5.3	*0.397*	20.3 ± 5.1	22.3 ± 5.6	20.4 ± 5.5	*0.282*	21.4 ± 5.6

Table 4.3. Weight status at baseline and 12-months.

		Baseline Weight Status				12-Month Weight Status			
Weight Status		Boys	Girls	*p*	All Children	Boys	Girls	*p*	All Children
Normal Weight	N	9	12		21	8	13		21
	%	43%	63%		52.5%	38%	68%		52.5%
Overweight/Obese	N	12	7		19	13	6		19
	%	57%	37%		47.5%	62%	32%		47.5%
				0.199				*0.06*	
Total	N	21	19		40	21	19		40
Percent of total	%	100%	100%		100%	100%	100%		100%

At both baseline and 12-months, the largest percentage of the sample shifted towards higher percentile ranges for BMI, and as previously reported (see Chapter 3), there was no relationship between weight status and energy intake (Figure 4.1 and 4.2).

Figure 4.1. Baseline BMI-for-Age and energy intake, all children (n =40)

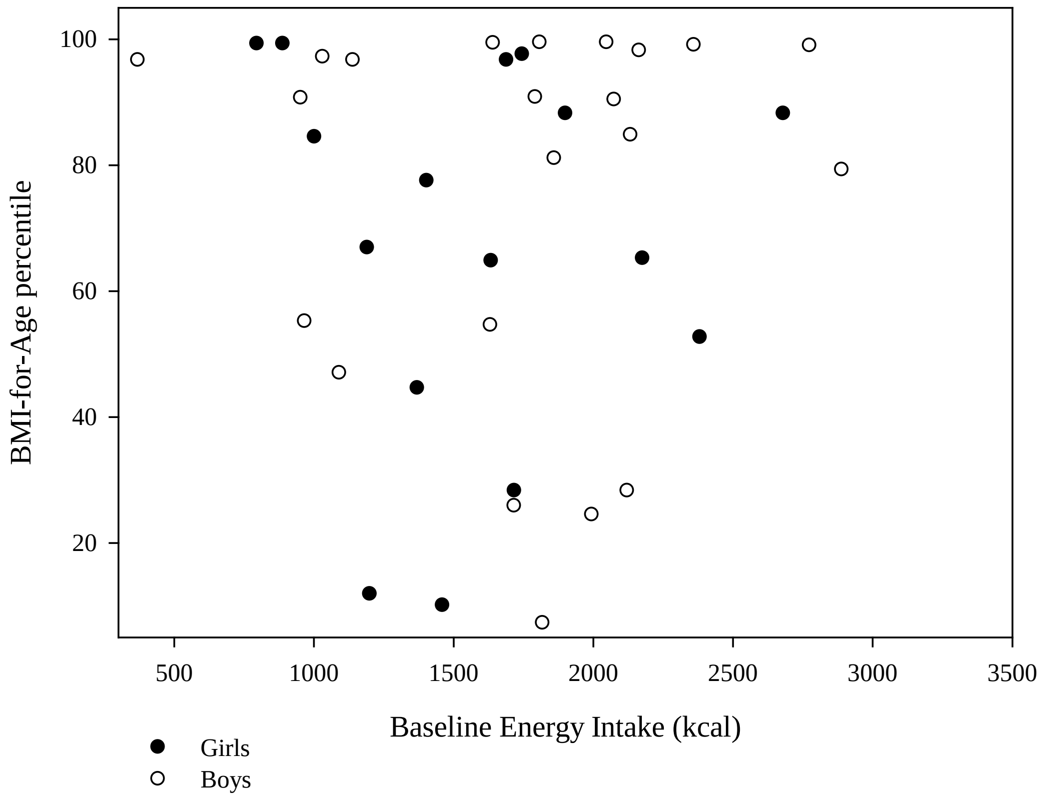
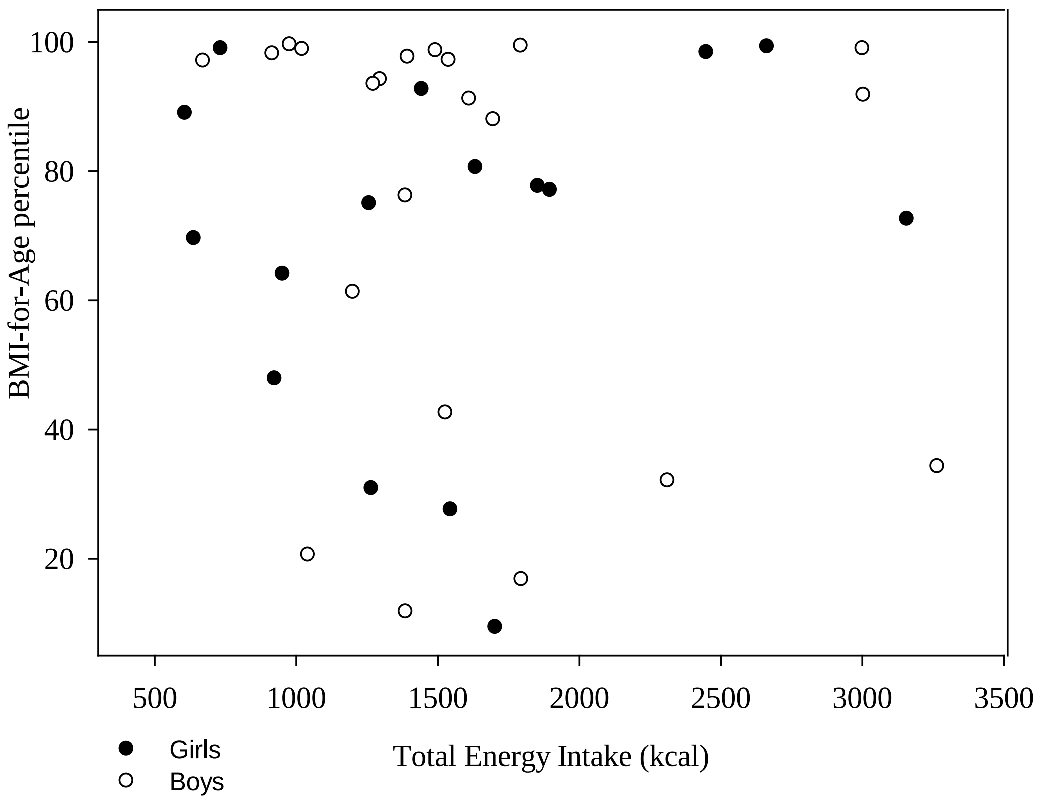


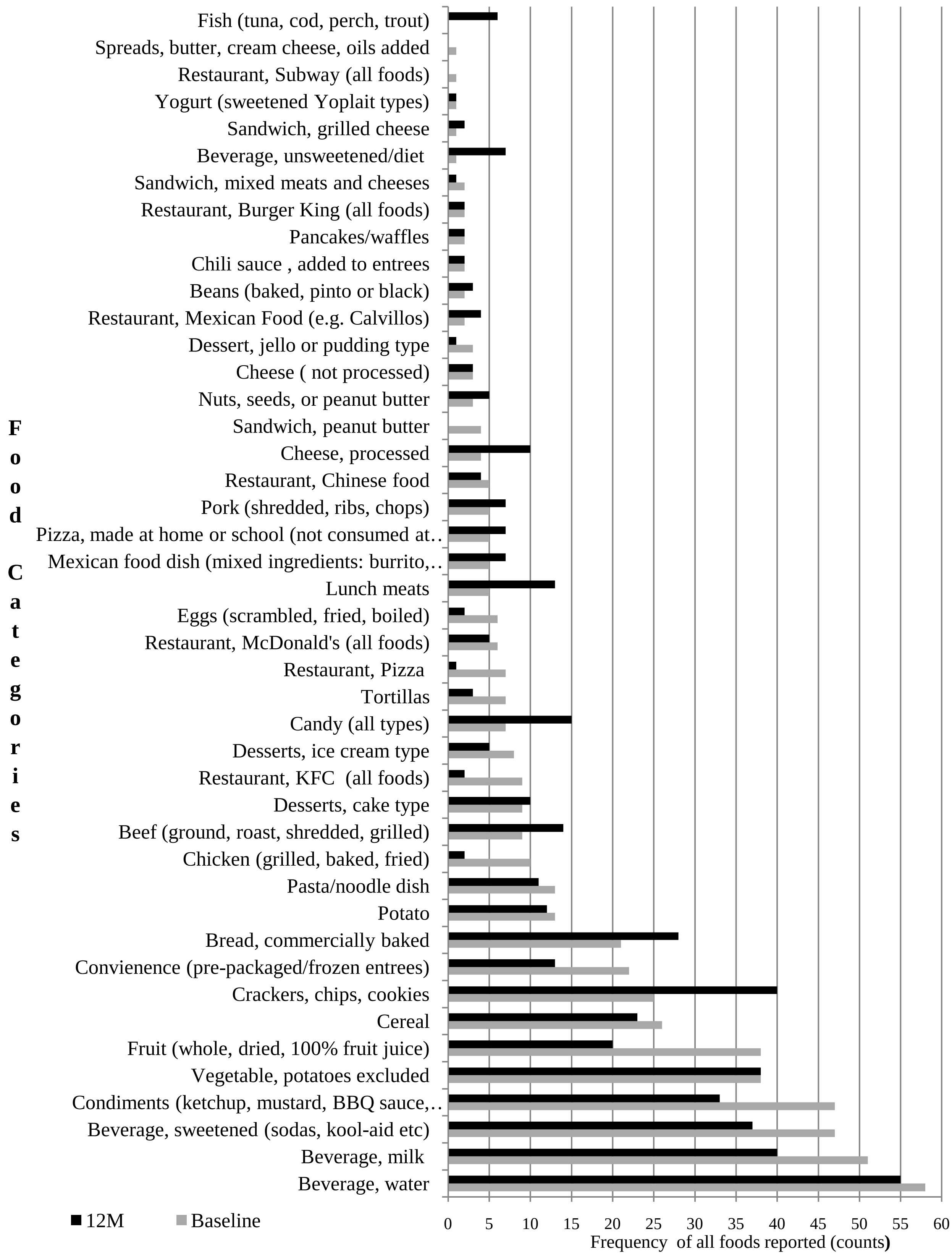
Figure 4.2. BMI-for-Age percentiles and energy intake at 12-months, all children,(n = 40)



Food Type Categories

All of the foods reported at the baseline and 12-month recalls were grouped into 45 different food categories adapted from categories used for food composition tables (United States Department of Agriculture 2010). These categories were then sorted by reporting frequency (least to most common) at baseline (Figure 4.3, see Appendix 4.1 for detailed description of foods included in categories). Similar types of foods were reported in both recalls. At both baseline and 12-months, beverages were the most frequently reported food type. Yogurt, butter, sandwiches and fish were some of the least frequent foods reported (Figure 4.3).

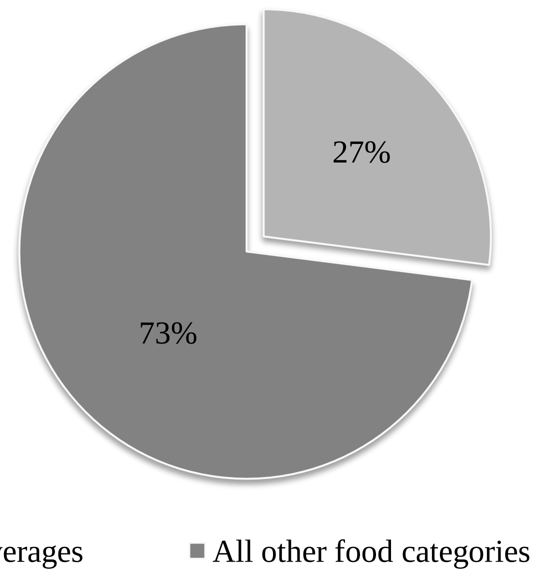
Figure 4.3. Frequency of foods reported at baseline and 12-months among 40, 7-10 year olds.



Beverage consumption

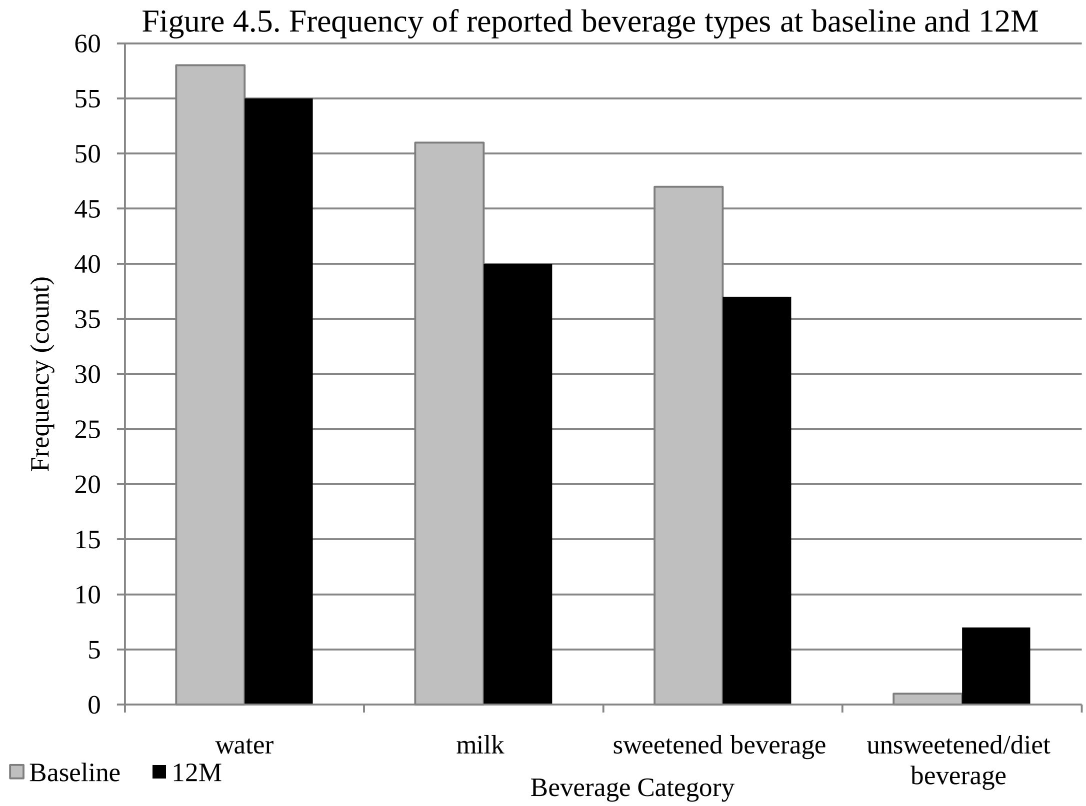
As previously mentioned, beverages were the most commonly reported food category. Reported beverages composed 27% of all the foods reported at baseline and 12-months (Figure

Figure 4.4. Percentage of beverages reported in both recalls



4.4).

The most frequently reported beverage was water, followed by milk, and then sweetened (e.g. soda, sports drinks, kool-aid) and unsweetened (e.g. black coffee or tea, diet sodas, sugar-free kool-aid) beverages (Figure 4.5).



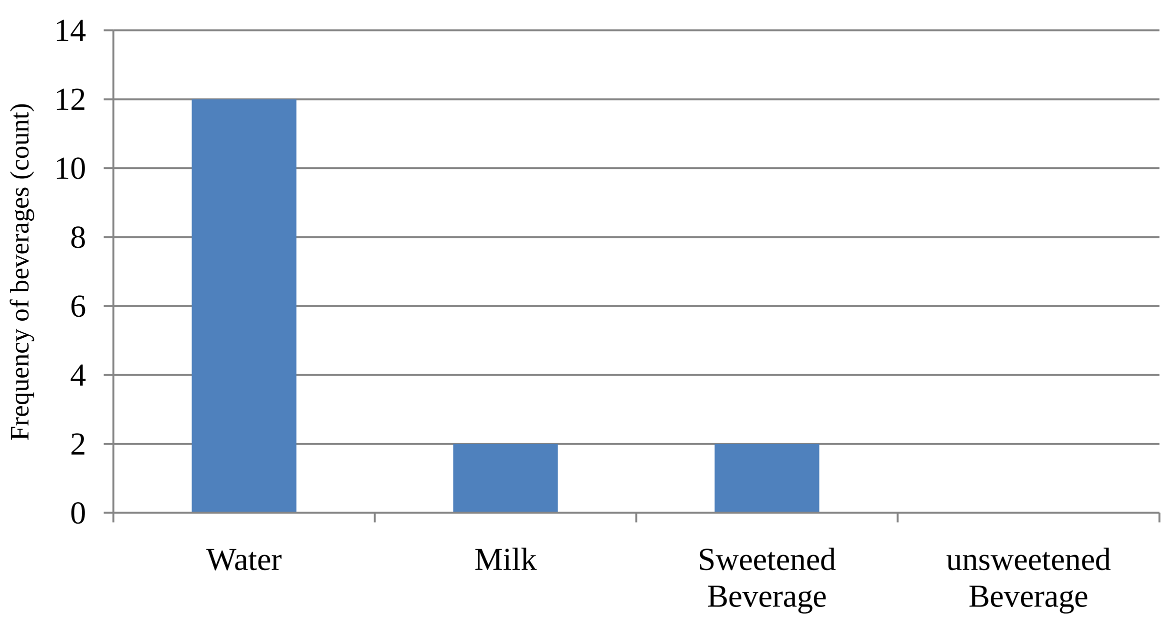
While beverages were most frequently reported, at both baseline and 12 months, beverage consumption only contributed to 14.8% and 16.8% of total energy intake (Table 4.4). These calories were from milk and sweetened beverages, as the water and diet beverages reported had zero caloric content. Although calories from sweetened beverages tended to be slightly higher than calories from milk at baseline; there were no significant differences between the energy intake from sweetened beverages and milk (paired *t-test*).

Table 4.4. Contribution of calories from beverages at baseline and 12-months.

	Baseline		12-months	
	kcal	% of kcal	kcal	% of kcal
Total energy intake	1655 ± 572	100%	1569 ± 693	100%
Water	0	0	0	0
Milk	116 ± 40	7.0%	133 ± 59	8.5%
Sweetened Beverage	129 ± 45	7.8%	130 ± 57	8.3%
Unsweetened Beverage	0	0	0	0
Total contribution to intake	245 ± 85	14.8%	263 ± 116	16.8%

The frequency of beverages reported at both the baseline and 12-month recalls were similar to beverage consumption patterns during the observations of 5 individuals following their 12-month recall (Figure 4.6).

Figure 4.6. Frequency of beverage types consumed during observations (n =5)



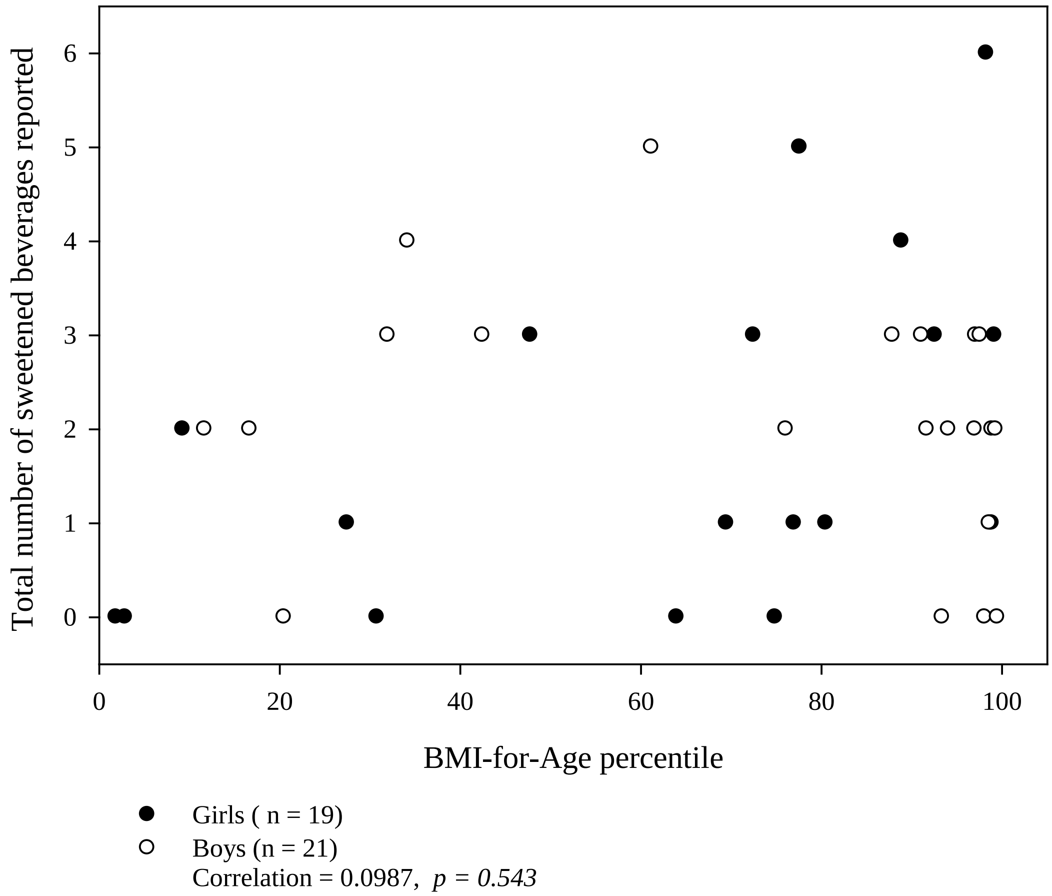
During the observations, two of the children consumed milk, and one child consumed a sweetened tea and sweetened orange drink during the observations. None of the children were observed drinking diet sodas or unsweetened tea or coffee.

The beverage consumption patterns observed in the recall data were also similar to those observed during school visits between 2007 and 2009. At all of the schools visited, students were allowed to keep water bottles. During school breakfast and lunch, milk was served. At one school, milk was served to students during the afternoon snack period.

The results from the recalls and observational data do not support the first hypothesis tested: At both baseline and 12-months, sweetened beverages will be the most frequent type of beverage reported, and milk will be the least frequent.

Finally, although beverages were the most commonly reported food type, and sweetened beverages contributed on average, 8% of total energy intake, there was no association between the total number of sweetened beverages reported and BMI-for-Age percentile (Figure 4.7).

Figure 4.7. Association between sweetened beverages and 12-month BMI-for-Age percentile



Location of eating occasions

The second part of this analysis examined the relationship between where children consumed food and weight status. Children reported eating occasions at home, school, restaurants and relatives' houses. At both baseline and 12-months, the most frequent place children reported eating was at home (Figure 4.8 and 4.9).

Figure 4.8. Baseline number of eating occasions at different locations, all children (n =40)

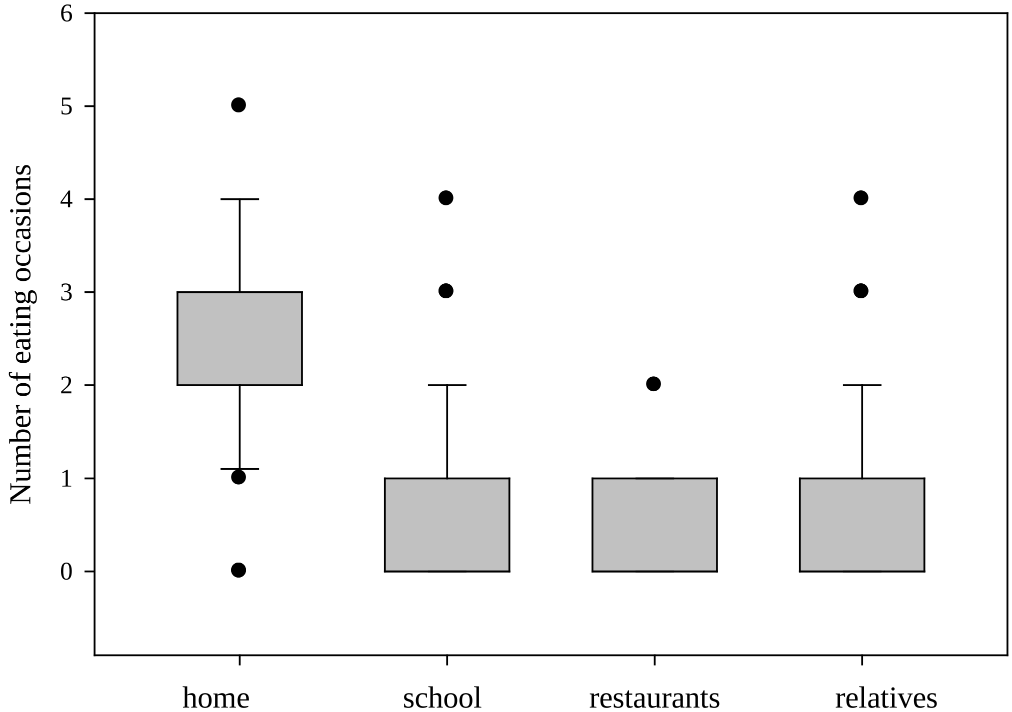
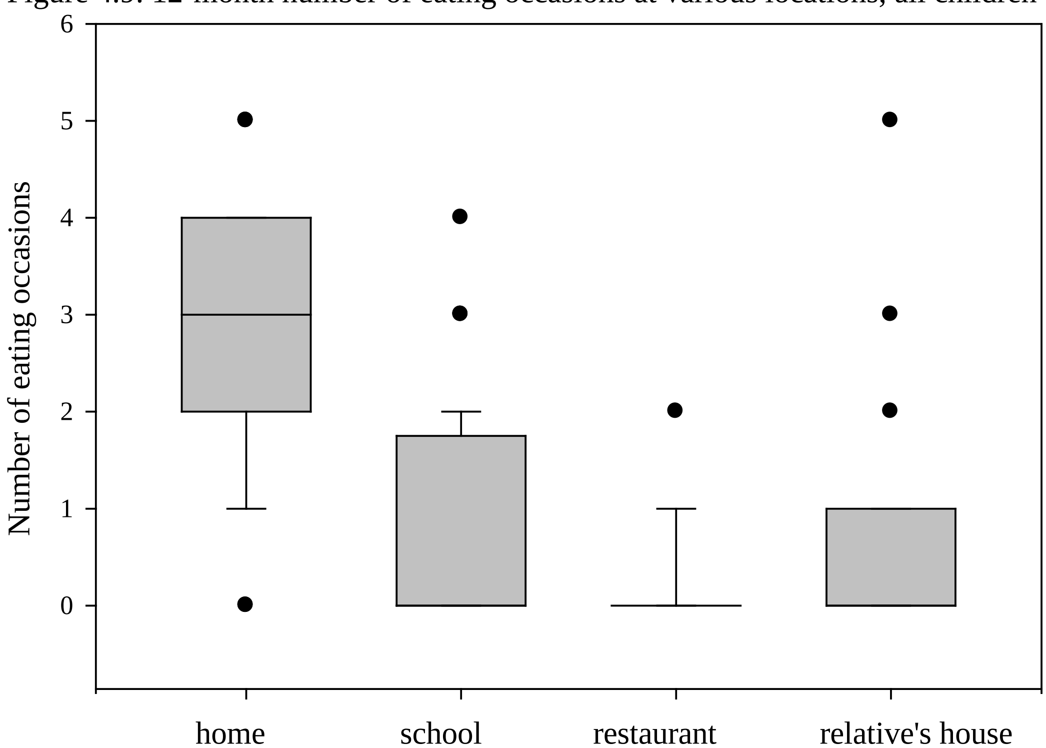
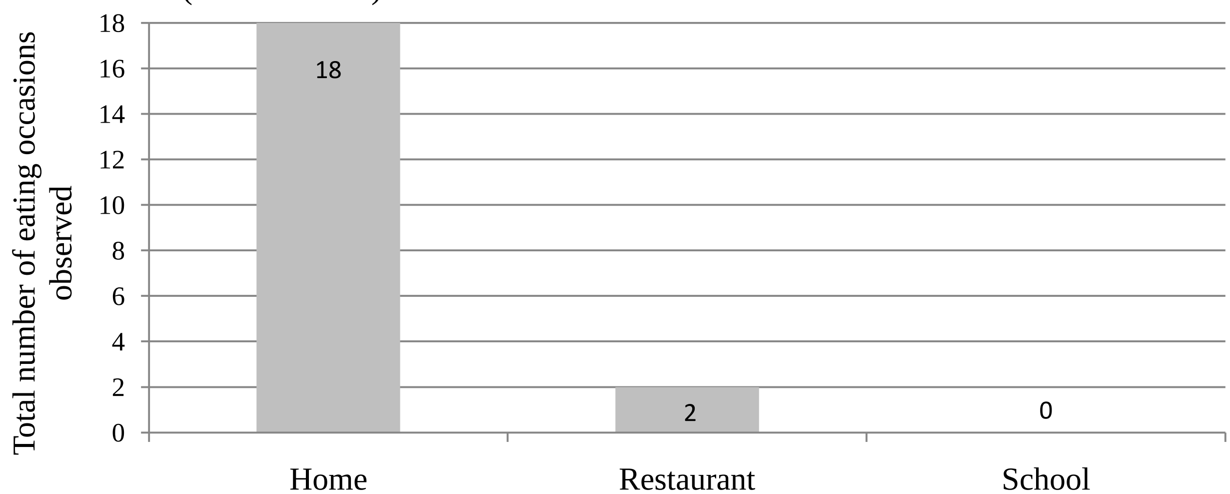


Figure 4.9. 12-month number of eating occasions at various locations, all children (n =40)



A similar pattern of eating occasions at home was observed in the observational study as well. All five of the children who participated in the supplemental observational study ate most of their meals at home. Four of the children ate all of their meals at home, which was consistent to what they reported in both their baseline and 12-month recalls. During one of the observation days, one child ate at a restaurant twice.. On this day, the child ate breakfast and lunch at a restaurant, but ate dinner at home (Figure 4.10). It was also noted, that this was not a typical weekday for the child; he happened to be participating in a community event at the park which began in the morning and lasted until the late afternoon.

Figure 4.10. Location of eating occasions during direct observations (n = 5 children)



Finally, the low number of eating occasions at restaurants is consistent with state-wide surveys which estimate low frequencies of fast food consumption among rural and urban children (2-14 years of age) in Colorado. In 2005 and 2006, when surveys were separated by rural or urban residence, 82% (n = 305) of rural children surveyed, reported eating fast food less than once a week, similar to the results reported here. However, in 2007, rural and urban areas were combined for the survey. When rural and urban areas were combined 41% of (n =690) all children interviewed reported eating fast food less than once per week, indicating a low state-wide frequency of fast food consumption.

Relationship between total energy intake and location of eating occasions

There was no relationship between total energy intake and the percentage of eating occasions at restaurants at either baseline or 12-months (Figures 4.11 and 4.12). Children with the highest energy intakes reported both high and low percentages of eating occasions at restaurants.

Figure 4.11. Baseline energy intake vs. percent of eating occasions at restaurants.

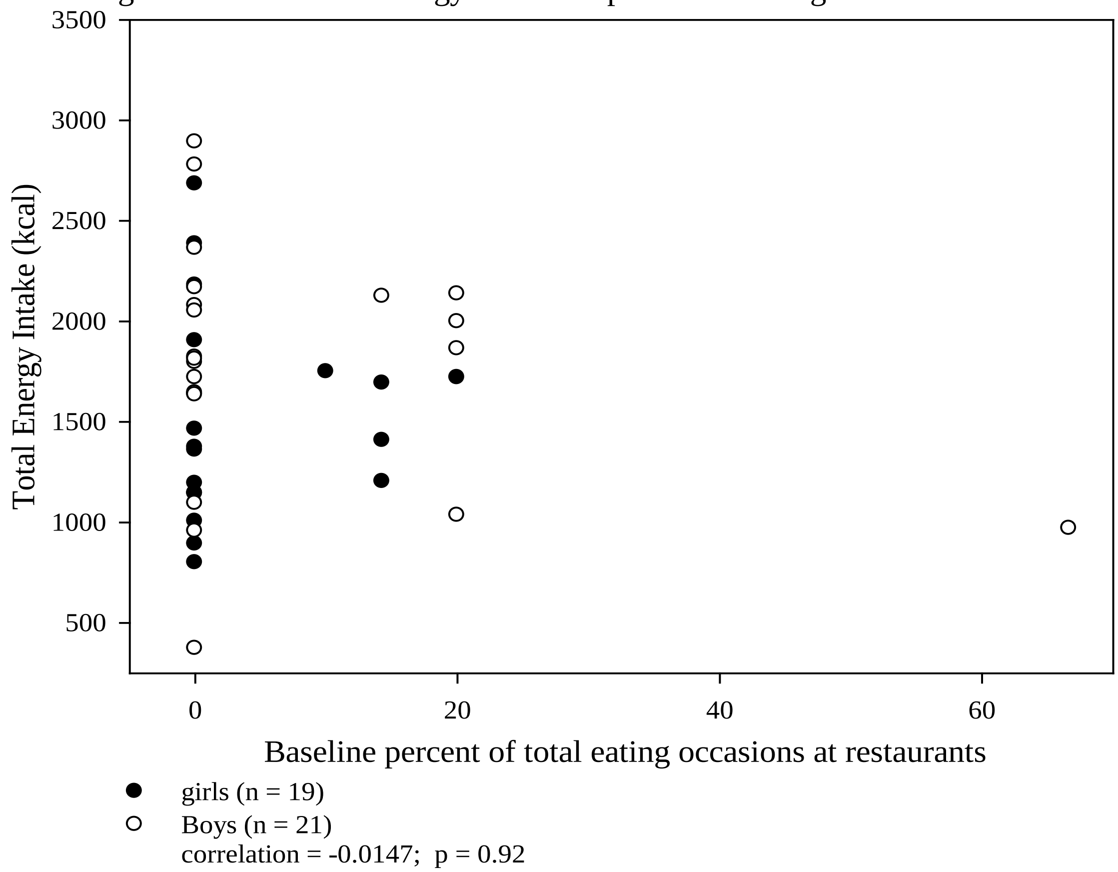
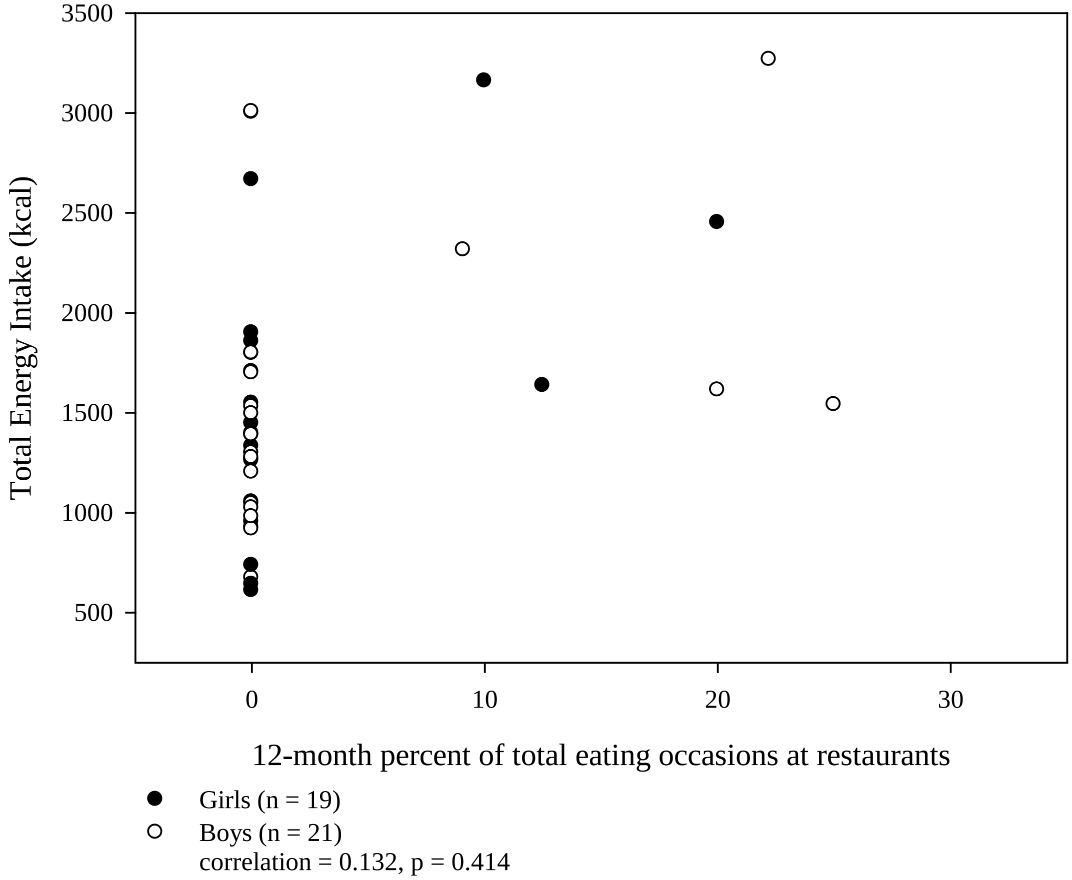


Figure 4.12. 12-month total energy intake vs. percent of eating occasions at restaurants.



Relationship between eating occasion locations and weight status

There was no relationship between the percentage of restaurant eating occasions and weight status. Children with the highest BMI-for-Age percentiles had a similar percentage of eating occasions at restaurants to children with the lowest BMI-for-Age percentiles at both baseline and 12-months (Figure 4.13 and Figure 4.14).

Figure 4.13 Baseline percentage of eating occasions at restaurants vs. BMI-for-Age percentile.

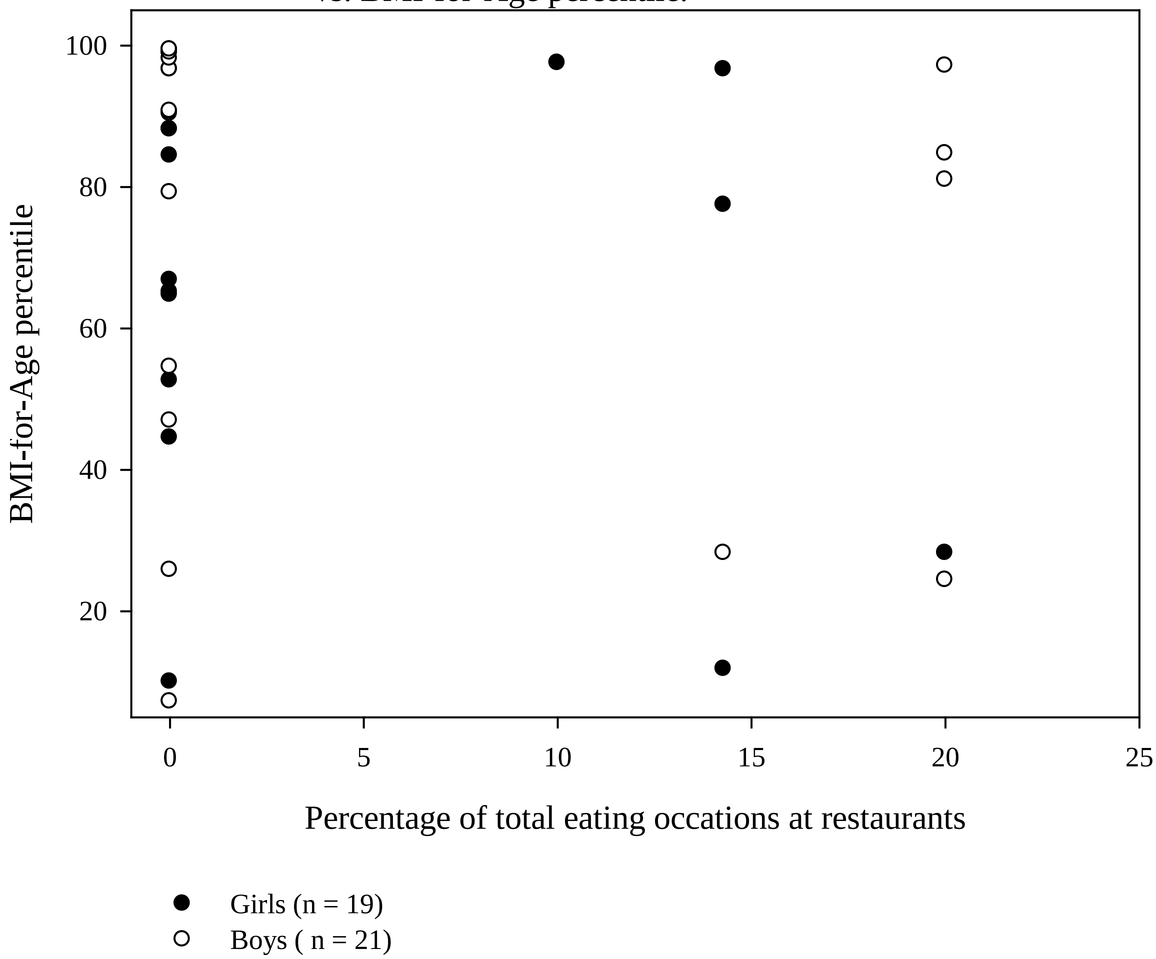
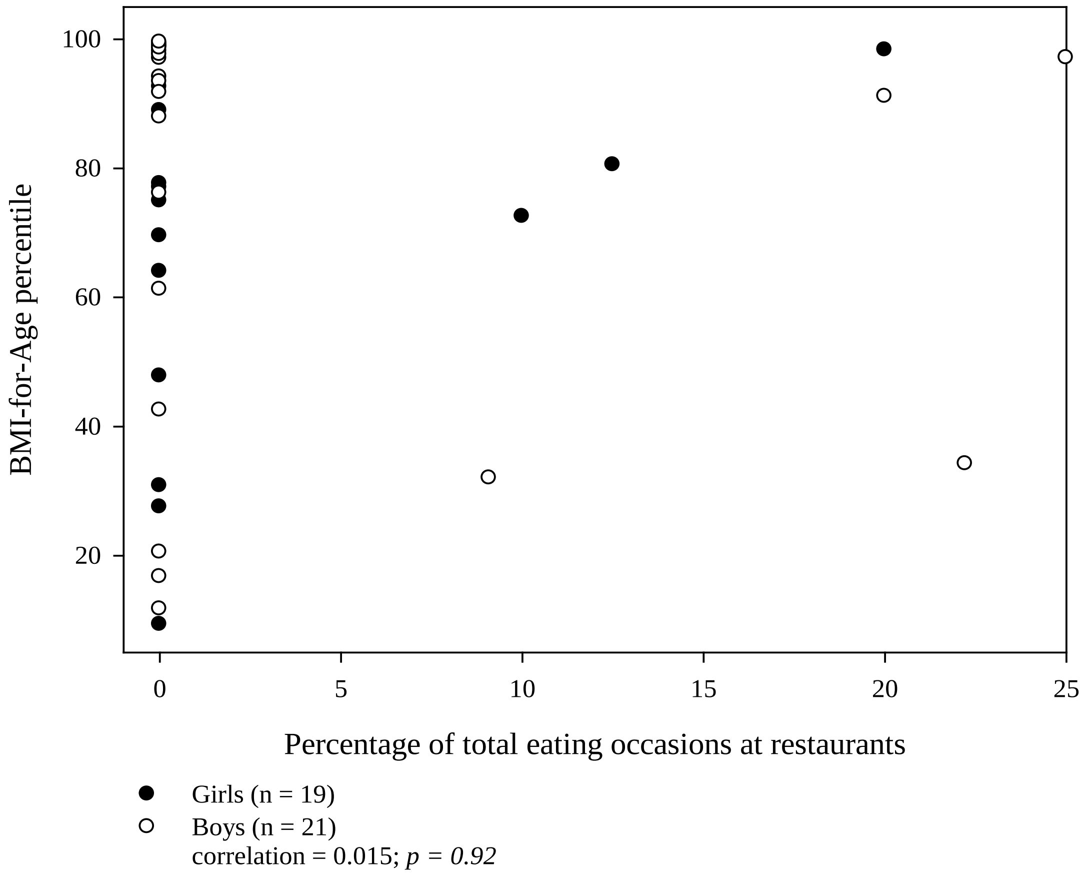


Figure 4.14. 12-month percentage of eating occasions at restaurants vs. BMI-for Age percentile



These results do not support the second hypothesis tested: H_2: Children with a higher percentage of eating occasions at restaurants will have higher BMI-for-Age percentile than children with a lower percentage of eating occasions at restaurants.

DISCUSSION

In this sample, water and milk were the most commonly reported beverages among elementary school children. The analysis of beverage frequency in this sample did not support the first hypothesis tested: At both baseline and 12-months, sweetened beverages will be the most frequent type of beverage reported, and milk will be the least frequent. Furthermore, there was no association between sweetened beverage consumption and weight status.

In the second part of the analysis, although some children reported eating at restaurants, the most common location for eating occasions was at home. As such, there was no association between the percentage of eating occasions at restaurants and total energy intake or weight status. The results of the second part of the analysis did not support the second hypothesis tested: Children with a higher percentage of eating occasions at restaurants will have higher BMI-for-Age percentile than children with a lower percentage of eating occasions at restaurants.

French et al. (2004) reported an increase in sweetened beverage consumption among US children who participated in the Continuing Survey of Food Intake (CFSI) between 1977 and 1998. Similarly, Nielsen et al. (2004) reported an increase in sweetened beverage consumption (135%) and decline in milk consumption (38%) among children and adults who participated in NHANES dietary recalls between 1977 and 2001. However, the pattern of beverage consumption among the children in this study differs from the patterns reported by Nielsen et al. (2004) and French et al. (2004) who both reported high intakes of beverage consumption and low intakes of milk consumption. Furthermore, the pattern observed in this study is more similar to patterns reflected in state-wide child nutrition surveys. In 2007, the percentage of 1-14 year-olds (n = 1713) in Colorado who consumed 2-4 servings of dairy per day, is higher than the percentage of children who consume more than 2 servings of sweetened beverages (e.g carbonated soda, sports drinks, kool-aid, less than 100% fruit juice) per day (30.1% and 3.8% respectively) (Colorado Department of Public Health and Environment 2007).

Among the sample of children in this study, water was the most frequently reported beverage, and the frequency of milk consumption was slightly higher than that reported for sweetened beverages. The high frequency of water consumption, and relatively low frequency of sweetened beverage consumption was further supported by observations of 5 of the 40 children in the sample. During the observations, water was the most frequently consumed beverage for all but one of the children. In this subsample, all but one of the children consumed water throughout the day without any type of encouragement from adults. The pattern of water consumption typically observed as follows: the children would be engaged in an activity (e.g. watching television, playing outside, and playing on the computer), they would stop their activities for a minute, walk to the kitchen and fill a glass of water and drink it. A similar pattern of water consumption was also observed outside of the home. One of the children was observed while participating in a community event at the local park. The event organizers had bottles of water and soda available for the children. During the event, this particular child chose to consume a bottle of water instead of the soda that was available. Similarly, a second child who was observed attended a Vacation Bible School event on one of the evenings of the observation. During the snack break, children were provided with refreshments, which included a choice of: bottled water, kool-aid drink or lemonade, and a snack mix (e.g. a mix of pretzels, cereal, peanuts). The child being observed grabbed bottled water instead of the other beverages available.

While the children being observed chose to drink water on their own, without a parent or other adult encouraging them, the high frequency of water consumption both observed in recall data and direct observations may reflect previous adult encouragement, either from teachers, parents or other adult relatives. The high water intake may also reflect one aspect of living in a semi-arid, relatively high alpine valley, which may result in adults encouraging children to consume water when they get thirsty. The humidity is low in the Valley, and during informal and formal interviews with parents, teachers, other school staff and adults talked about the dry, cold air in the Valley, as well as the importance of staying properly hydrated under such conditions. Case in point, one school principal talked about how the Valley is dry, windy and cold, and how students are encouraged to keep filled water bottles on their desks. The same principal also talked about making sure that children are provided with a new water bottle if they forget theirs, as well as the signs that teachers look for to determine whether or not children are properly hydrated (e.g. very chapped lips, dry eyes, dry skin etc.). These beliefs and the encouragement to drink water may be one contributing factor to the relatively high water intake among children in this sample. Likewise, these beliefs and behaviors may also serve as a mitigating factor towards low sugared beverage consumption. Perhaps, the high water consumption displaces sweetened beverage consumption.

A second explanation for the high frequency of water consumption among children in this sample could be the lack of easy access to vending machines or stores. At the time of this study, there were no vending machines in the schools that the children attended, so children did not have easy access to soda machines at school. Additionally, some of the children live in the smaller towns, where corner stores and grocery stores are less accessible; either they are not present or in close proximity, or the stores have limited hours of operation. On the other hand, water is easily accessible at school and at home.

While the frequency of water consumption was higher than any of the other beverages, it made no contribution to total energy intake. However, sweetened beverages and milk, while less frequently consumed, contributed to total energy intake. The caloric contribution to total energy intake for both milk and sweetened beverages was similar, but there were no significant decreases or increases in either milk or sweetened beverages between the baseline to 12-month measurements. At baseline and 12-months, milk and sweetened beverages contributed to less than 10% of total energy intake (7% and 7.8% and 8.5% and 8.3% respectively). These results are lower than those data reported by Wang et al. (2008) for a nationally representative sample of children, which reported that sweetened beverages contributed 229 kilocalories or 11% of 6-11 year children's total energy intake.

The longitudinal results reported here do not show significant changes in food or beverage consumption patterns as children become older. Likewise, although the children in this sample were of different ages, (ranged between 7 and 12 years of age); there were no age dependent differences in beverage consumption patterns at either baseline or 12-months. In other words, youngest children reported beverage consumption patterns similar to those reported by older children in the sample. These results differ from previous studies by Lytle et al. (2000) and Blum et al. (2005), who have reported longitudinal declines in milk consumption among elementary school children. Lytle et al. (2000) reported a 5% decrease in milk consumption and a 5% increase in sweetened beverage consumption as children moved from 3rd grade to 5th grade; the authors argue that these changes represent a pattern among older school children in which they replace their milk consumption with sugary, sweetened beverages. Similarly, Blum et al.

(2005), reported a 7% decrease in milk consumption and a 3% increase in sweetened beverage consumption among 164 elementary school children (3^{rd} to 5^{th} grade) interviewed at a baseline measurement (9.3 ± 1 years of age) , and then again 2 years later (10.7 ± 0.9 years of age). These studies differ from the San Luis Valley sample in that the period between measurements was longer. Perhaps, a 12-month interval is too short to observe changes in food consumption patterns. On the other hand, the age ranges in these studies were similar to those for this study at baseline and 12-months. Therefore, the differences between this sample and previous studies by Lytle et al. (2000) and Blum et al. (2005) may reflect dietary habits unique to the Valley; as the dietary patterns reflected by children in this sample are similar to patterns reported for children and adolescents in the late 1970's (Nielsen et al. 2002). Finally, because milk and sweetened beverage consumption were similar in their contribution to energy intake, it does not appear that children in the Valley are displacing milk with sweetened beverages.

Blum et al. (2005) also found an association between diet soda (unsweetened beverages) consumption and overweight children in their sample. Among overweight children in the Blum et al. (2005) study, diet soda consumption increased and milk consumption decreased over the 2 year period. These results also differ from the Valley sample, where there were no changes in milk consumption and diet sodas were the least commonly reported beverage. Moreover, there was no association between beverage consumption (of any type) and weight status. Although the results here differ from Blum et al. (2005) who reported on elementary school children, the results are similar to those reported for low-income preschool children in North Dakota (Newby et al. 2004).

The second part of this study examined restaurant use, which has been attributed to decreases in diet quality and increases in childhood obesity in the United States (Nielsen et al.

2002; Bowman et al. 2004). Although a few children in this sample reported eating at restaurants, the most common place to eat was at home. This pattern was further supported by direct observations of the 5 children who were followed by a researcher. With the exception of one, these children lived in Monte Vista and Alamosa, and were within a mile or two of at least one restaurant. However, all but one of the children ate their meals at home. The eating occasion patterns observed here are different than those reported for national data, but are consistent with state-wide surveys in Colorado, where parents have reported low fast-food consumption among their 1-14 year old children (Colorado Department of Public Health and Environment 2008).

Likewise, there was no relationship between percentage of eating occasions at restaurants and energy intake, nor was there a relationship between restaurant use and weight status. These results are different than those reported by Gonzales et al. (2002) for 5th graders in Rural West Virginia and those reported by Bowman et al. (2004) for US children and adolescents Among the 325 children in the West Virginia study, there was a positive association between number of meals consumed away from home and total energy intake. Likewise, in the Bowman et al. (2004) study, children who reported eating at restaurants, had significantly higher energy intakes than children who did not eat at restaurants.

The food consumption patterns observed in both the recalls and direct observations of the children in this study are different than previous studies which have examined restaurant use among children in the United States, and are more similar to patterns reported in the late 1970’s. In 2002, Nielsen et al. examined trends in food consumption reported by US adults and children in the Continuing Surveys of Food Intake by Individuals (CSFII), and reported a significant increase in the percentage of meals consumed at restaurants for US adults and children. In their study, they reported an increase from 9.6% to 23.5% between 1977 and 1996. However, in this study, the average percentage of eating occasions at restaurants was 4.4% for baseline and 12-months. These results are lower than those reported for nationally representative samples of children in 1977, and much lower than those reported in 1996. More recently, Bowman et al. (2004) used the CSFII to examine food consumption patterns of US children, and found that 30% of the 6212 children reported eating fast food at least once a day. Again the pattern observed in these larger samples is quite different from that observed among the children in the San Luis Valley.

It could be argued that part of the difference between the large national surveys and the data reported here is be related to the small sample of children in this study. This study only included 40 children from an area which has over 9,000 children between 1 and 14 years of age (Colorado State Demographic Office 2008). On the other hand, data sets from national surveys are typically very large and are considered to be more representative of all US children. However, despite the small sample, the patterns reported here are similar to those observed in households, schools and communities throughout the Valley, and thus suggest a regional pattern that differs from other parts of the United States. For example, the patterns observed among the families of the 5 children who participated in the supplemental observational study are similar to those reported in their own as well as other participants' dietary recall data. Furthermore, observations conducted during visits to elementary schools between 2007 and 2009, are also similar to patterns of school food consumption reported in the dietary recalls. Finally, the results reported for this sample are consistent with estimates of milk and fast-food consumption reported in the Colorado Child Health Surveys. These similarities suggest that the patterns seen in the recall data are likely representative of the dietary patterns among the children in this sample, and while the sample was small, the data reflect common food consumption behaviors among children in the Valley.

It is also important to note here, that another difference between the patterns observed in this sample and larger national samples could be related reduced availability due to the number, location and operating hours of restaurants in the Valley. As previously mentioned, the Valley is relatively dispersed. There is one large central, more developed town, Alamosa, which is surrounded by smaller rural, towns with less retail (e.g. stores, restaurants, small businesses). Furthermore, stores and restaurants in some of the smaller towns, have limited hours of operation. For example, in one of the smaller towns, there was only one “family style” restaurant, which was only open for breakfast. In another town, the grocery store closed at 8pm.

The majority of large restaurants and stores are located in Alamosa. There are about fifteen family style, “sit-down” restaurants located in and around the old main street of Alamosa. However, all of the fast-food restaurants (seven total) and large chain grocery stores (three) are clustered together along a 2 mile stretch of the main highway (Highway 160) which passes through Alamosa.

The location and variability in business hours of restaurants and stores could have a “food desert” effect on families living in these outer towns. For some families who live in some of the smaller towns outside of Alamosa, it is a 15 to 30 minute drive to get to a restaurant, and for some families, access to a car is difficult. Instances of limited access to restaurants and cars were noted during the supplemental observations study, as well as during interviews with school staff. This limited access may partially explain why restaurant use is lower among children in the Valley. It may also explain why there tended to be more processed (e.g. frozen, canned foods) foods, and fewer fresh fruits and vegetables reported in the dietary recalls.

The association between food access (e.g. “food deserts”) and food choice and consumption has been examined for urban and rural adults living in England, Ireland, Canada and North America (Pearson et al. 2005; Furey et al. 2001; Apparcio et al. 2007 and Hendrickson et al. 2006). The results of these studies have varied, and the association between food consumption patterns and retail food access is still not well understood. Some studies report no association between car ownership, access grocery stores and food consumption patterns (Pearson et al. 2005). Meanwhile, other studies have reported direct association between car ownership, retail food availability and food choice (Hendrickson et al. 2006; Furey et al. 2006).

Despite the conflicting results reported by previous studies, both the quantitative data (recalls) and qualitative data (observations and interviews) in this study suggest that restaurant and store access does influence food consumption patterns of families in the Valley, and there may be a “food desert” pattern in parts of the Valley. For example, during a key informant interview, a school principal briefly talked about the lack of large grocery stores or chain restaurants in Center, and the families who lived in Center (about 20 miles north of Alamosa), and did not own cars. These families relied on neighbors or extended family members for rides to Alamosa to go shopping. In these cases, families would plan a trip to Alamosa about once a month. Similarly, during one of the household observations, it was noted one of the children was from a family who did not own a car. In this family, the parent relied on an extended family member for access to a car. The family member who provided access to the car, lived in the next town which was 17 miles away. Under these circumstances, going to restaurants was more difficult. Although the family lived in a town that had restaurants and a store, they either had to walk to one of the three restaurants in their town (about 2 or 3 miles from their house), or get a ride from a friend or extended family. Finally, another child who was observed lived in one of the smaller outer towns. There was one breakfast type restaurant in this town, and the nearest fast-food or large dinner restaurant was a 20 minute drive north. Again, eating at home was more convenient for this family.

Interestingly, popular media and some research have linked sweetened beverage consumption and fast-food/restaurant use to excessive energy intake. As such, these dietary behaviors are linked to the obesity epidemic (Holguin 2003; Nielsen et al. 2004; Ludwig et al. 2001 Chou et al. 2008). However, this study suggests that children in the San Luis Valley are not consuming excessive amounts of sweetened beverages and fast food or restaurant food. Rather, the data suggest that these children have patterns of beverage consumption restaurant use similar to those reported for children and adolescents prior to the recent obesity epidemic in the 1970's. (United States Department of Agriculture 1983; Bowman et al 2004; Nielsen et al. 2002; Blum et al. 2005; Lytle et al. 2000). Yet, despite these differences in food consumption patterns, almost half of the children in this sample were overweight or obese, suggesting a high prevalence of childhood obesity in this population, much like the rest of the United States. Likewise, obesity is a still a concern among school administrators, public health nurses and researchers working in the Valley. The results presented here and the ongoing concerns with obesity in the Valley suggest that there may factors other than excessive energy intake through sweetened beverages and restaurant foods are contributing to weight gain among children in this population. Perhaps, physical activity plays a more important role in weight status than diet.

CONCLUSION

Among children in this study, sweetened beverages and eating at restaurants are less common than that reported for nationally representative data, and may not be a contributing factor to the high BMI-for-Age percentiles observed in this sample. These results do not support either of the hypotheses tested, and are similar to observations and information provided by community members through informal interviews between 2007 and 2009. The relatively low sweetened beverage consumption and restaurant use in this study may be related to: 1) encouragement by adults to stay hydrated in a dry, arid environment; and 2) a “food desert” effect caused by limited access to convenience stores and restaurants.

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CHAPTER V:

PHYSICAL ACTIVITY PATTERNS AMONG CHILDREN IN THE SAN LUIS VALLEY, COLORAO

INTRODUCTION

In recent years, number of US children who are overweight or obese has increased. Between 2003 and 2006, 33% of children between 6 and 11 years of age were overweight, and 28% were obese (Ogden et al. 2008). Reports also suggest that children in rural communities may be at greater risk of being overweight than urban communities (McMurray et al. 1999; Jackson et al. 2005; Patterson et al. 2004). What is less understood is the role of physical activity in children's energy balance, especially among rural school children. Self-report surveys suggest a relationship between overweight and low physical activity among children (Andersen et al. 1998). However, because these data have been collected using self-report surveys, there is the potential for significant reporting bias (Troiano et al. 2008). With improvements in activity monitoring devices, such as accelerometers, physical activity among children can be assessed with less reporting bias, and can provide information about physical activity among free living children over multiple days. Accelerometer data combined with ethnographic data from children and their families can further inform us about the determinants of physical activity, and perhaps lead to effective obesity prevention programs in communities with children who are at a high risk for becoming overweight.

The purpose of this study is to: 1) describe both objectively measured and qualitative assessments of physical activity among children between 7 and 12 years of age who were living in the San Luis Valley, Colorado between 2007 and 2009, and were participants in the San Luis Healthy Family Project; and 2) assess the relationship between physical activity and weight status.

Two hypotheses were tested in this study:

> H_1: Children with lower BMI-for-age percentiles will accumulate more activity counts than children with higher BMI-for-Age percentiles.
>
> H_2: Overweight and obese children will spend more time at sedentary activity levels, and less time at light and moderate activity levels than normal weight children.

METHODS

Study Site

The San Luis Valley is a rural six county geographic area covering 8,000 square miles in south central Colorado, about 250 miles from Denver, Colorado. Geographically the valley is relatively isolated, surrounded on 3 sides by mountain ranges (Sangre de Cristo and San Juan mountains) and only accessible from other parts of Colorado by 2, 9,000 ft. mountain passes (La Veta Pass and Poncha Pass) (McNoldy and Doesken 2007).

The valley was first settled between 1850 by a group of families moving north from New Mexico. One year later, a group of 50 families who had received land grants from Mexico settled the town of San Luis in the southern part of the Valley. Following these early settlements, other Spanish families migrated from New Mexico into the southern part of the Valley. After the Homestead Act of 1862, non-Hispanic settlers from Utah and the Midwest began to move into the northern part of the Valley (Andrews 2001; Carlson 1973).

Today, almost half of the residents in the Valley (43%) self identify as Hispanic, compared to the state of Colorado in which 18.9% self identify as Hispanic (Centers for Disease Control and Prevention/National Center for Health Statistics 2008). Unlike other areas, such as Texas or California, the Valley has seen very little migration from Mexico and most of the residents emphasize their Spanish ancestry over Mexican or Native American ancestries (Bonilla et al. 2004; Mullineaux et al. 2003).

In 2007, the total population in the San Luis valley was 48,460, residing in over 50 small towns within six counties (Colorado State Demographic Office 2008). Since 2007, there has been very little change in the population size of the Valley. Currently, Alamosa County is the largest area with a population of 15,424 (US Census Bureau 2010), and contains the largest and most developed town of Alamosa. Farming and tourism are the main sources of income for residents living in the Valley, but median incomes are lower than the state median. While there is some variation in income between towns, the median household income for the entire Valley is $34,597; where the median income for Colorado is $57,1848 (US Census Bureau 2010). In addition, the number of households living in poverty exceeds the state average. In 2008, 21% of households were under the Federal Poverty Level, compared to 11.2% for Colorado (US Census Bureau 2010).

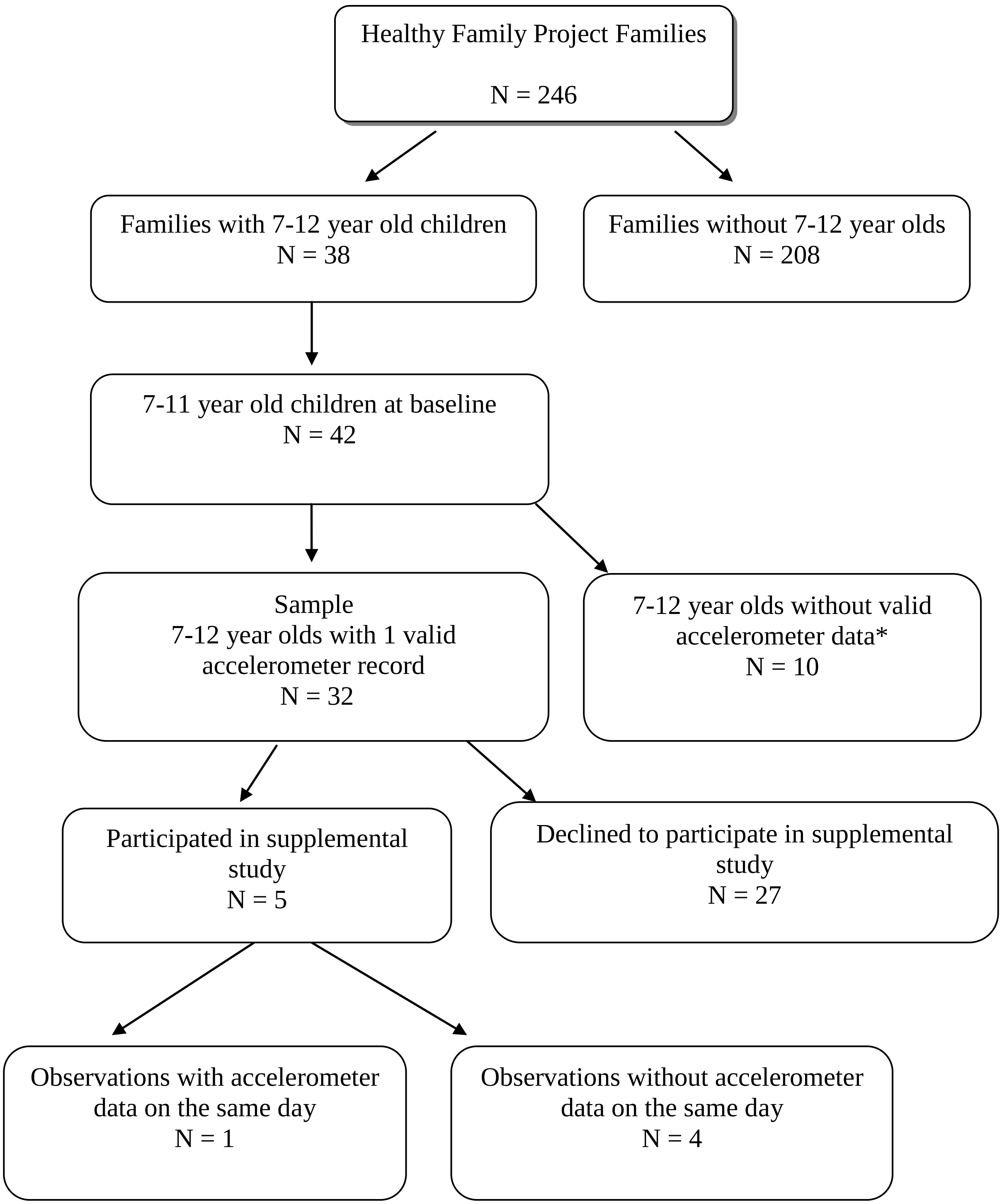
Because of the geographic location of the Valley, the population has remained relatively genetically isolated. In addition, the Hispanic population in the Valley has been found to be at high risk for type 2 diabetes obesity and rare mutation cancer, and has been the focus of studies examining related complex gene traits related to chronic disease (Bonilla et al. 2004; Mullieneaux et al. 2003). Currently, however, research in the Valley is focused on delaying or preventing the onset of type 2 diabetes through weight management, diet and physical activity.

Participants

Participants were 32 children between 7 and 12 years of age from families participating in the San Luis Valley Healthy Family Project, a 12 month randomized control study designed to test the effectiveness of home-based lifestyle coaching on dietary intake, physical activity patterns and weight status. Families participating in the Healthy Family project were scheduled for 3 clinic visits (baseline, 6 months, and 12 months) over a 12- month period. Each visit included a series of anthropometric measurements (height, weight, waist circumference and blood pressure), an interview which included questions about diet, physical activity, health care, and community resource use, and a 24-hour dietary recall interview at the baseline and 12-month visits. In addition, families were asked to wear an accelerometer for the 7 days following their baseline and 12 month clinic visits.

A total of 246 families participated in the study; 38 families had one or more children between 7 and 11 years of age at baseline (Figure 5.1). Children who completed the Healthy Family Project study (2 dropped out) were also invited to participate in a supplemental study following their 12-month clinic visit. The study included having a researcher observe their daily activities. Five children and their parents agreed to participate in the supplemental study. Written informed consent was signed by at least one parent, and assent forms were signed by all participating children. All research was approved by Colorado Multiple Institution Research Board.

Figure 5.1. Sample selection from the San Luis Valley Healthy Family Project



**Child declined to wear accelerometer or accelerometer was not functioning and counts were not recorded and saved.*

Ethnicity

Children's ethnicity was based on self-reported data. During clinic interviews parents and their children were asked the following questions about ethnicity: 1) "Is *(name's)* Spanish or Hispanic orgin?" (yes or no, don't know, refused); 2) "If yes, which of the following best describes *(name's)* heritage" (Mexican, Mexican American, Chicano, Cuban, Puerto Rican, Guatemalan, Other Spanish/Hispanic) 3)"What is *(name's)* race?" (White, African American, Black, Asian, Pacific Islander, American Indian, Alaska Native, Other, Don't know, Refused).

Anthropometry

Height and weight measurements were collected during baseline, 6-month and 12-month clinic visits for the Healthy Family Project. Height was measured to the nearest 0.10 cm using a permanently wall-mounted Accustat stadiometer (Genetech Inc). Weight was measured to the nearest 0.5 kilogram using a balance scale. BMI was calculated as weight (kg) / height (m^2). Weight status was classified based on the National Center for Health Statistics and Centers for Disease Control and Prevention 2000 age and gender specific BMI-for-Age percentiles. Children who had a BMI that fell between the 5th and 84th percentile were classified as normal weight. Those who had a BMI between the 85th and 94th percentile were classified as overweight and those with a BMI which fell above the 95th percentile were classified as obese, following the recommendations for weight status by Barlow et al. (2007)

Physical Activity Observations

Five children agreed to allow an observer to follow them and record their activities throughout the day. On the observation day, the researcher arrived at the child's house in the morning and spent the day with the child until late evening after dinner. During the observation, location (school, home etc.), type of activity, body position, activity intensity were all recorded into a data recording sheet. Physical activity was recorded at 1-minute beginning when the researcher arrived at the child's home, and ending when the researcher, left the child's home. Also included in the observation data were notes on the weather, whether or not food was present, and whether or not parents, siblings, or friends were present. A sample of the data recording sheet is attached in Appendix 5.1.

The activities included in the observation notes were then grouped into a smaller set of categories based on the most commonly observed activities as well as body position and intensity. For this study, the following activity groups were used: sitting/sedentary activities, standing, watching television, milling around (no specific activity), light unstructured play, running/running games, jump-rope, trampoline, bicycling, light household chores, heavy yard work (moving rock, using heavy yard equipment), brisk walking, softball practice, and church activities (arts and crafts and games observed during summer vacation bible camp).

Measurement of Physical Activity

Physical activity was measured using an Actigraph 7164 (Actigraph, Ft. Walton Beach, Fl) accelerometer. The Actigraph 7164 accelerometer is a uniaxial activity monitor which is worn on the hip, and detects lower limb movements within a 0.5-7-Hz frequency range, and filters out high frequency vibrations such as riding in a car or a lawn mower. Physical movement (e.g. walking or running) is recorded as counts in 1 minute cycles (i.e. epochs) (MTI Health Services, FT. Walton Beach FL).

Participants were asked to wear the monitor during waking hours for 7 consecutive days following their baseline visit, and then again for 7 consecutive days following their 12 month clinic visit. If an individual skipped a day during the 7-day wear period, he or she was instructed to wear the accelerometer for an additional day immediately after the 7-day period. A total of 32 children from wore the accelerometer at baseline and/or 12 months.

In addition to wearing the accelerometer, all participants were asked to record the time that they put the accelerometer on in the morning, and the time that they took it off in the evening. Participants were also asked to record any time that they removed the accelerometer for 15 minutes or more, and record any extra days that they wore the accelerometer.

Data Reduction

After being worn, accelerometers were downloaded and saved on a clinic computer using Actisoft software (version 3.1.1). The files were then analyzed for valid days and minutes using the Actisoft software (version 3.1.1) and MAHUffe software (www.mrc-epid.cam.ac.uk). Prior to the final analysis, criteria for the minimum number of days worn and minutes per day were developed. Only files that met these criteria were analyzed to identify total activity counts per day, average activity counts per day, and time spent in moderate to vigorous physical activity.

Criteria for minimum number of days.

Children were instructed to wear the accelerometer for 7 days, but some did not wear the accelerometer for all 7 days, or the accelerometer was not functioning properly on all 7 days. In addition, a comparison of the accelerometer wear logs and accelerometer data indicated that the accelerometer was initialized to start at 8am on the first day of wear. In some cases, children reported wearing the accelerometer before 8am on the first day on their logs. This resulted in missed data on the first day, and hence the first day of wear was excluded from the analysis.

Previous studies (Masse et al. 2005; Matthews et al. 2002) have recommend between 3 and 5 days, and a minimum of 4 days monitoring in order to determine whether or not an individual meets physical activity recommendations. Among children, the recommended range is 4 to 9 days of monitoring (Trost et al. 2005).

Based on these recommendations, a 4-day minimum was used to determine whether or not a child's accelerometer data would be included in the analysis.

Criteria for a valid day.

Children were instructed to wear the accelerometer during all waking hours each day during the 7-day wear period, except when showering or swimming. However, there were cases where children did not wear the accelerometer during some waking hours, or the accelerometer stopped recording during the day. In order to standardize the number of hours analyzed, a minimum wear time was used to determine a valid day for analysis.

Currently, there is not a standard number of hours used to define a valid day. For adults ,a widely used cut off is 10 hours (600 minutes) (Gemmil 2008; Janz et al. 1995; Matthews et al. 2002; Trost et al. 2000; Masse et al. 20005). A study by Masse et al. (2005) tested 4 different definitions for valid days, and found that a minimum of 10 hours provided the most representative sample for physical activity.

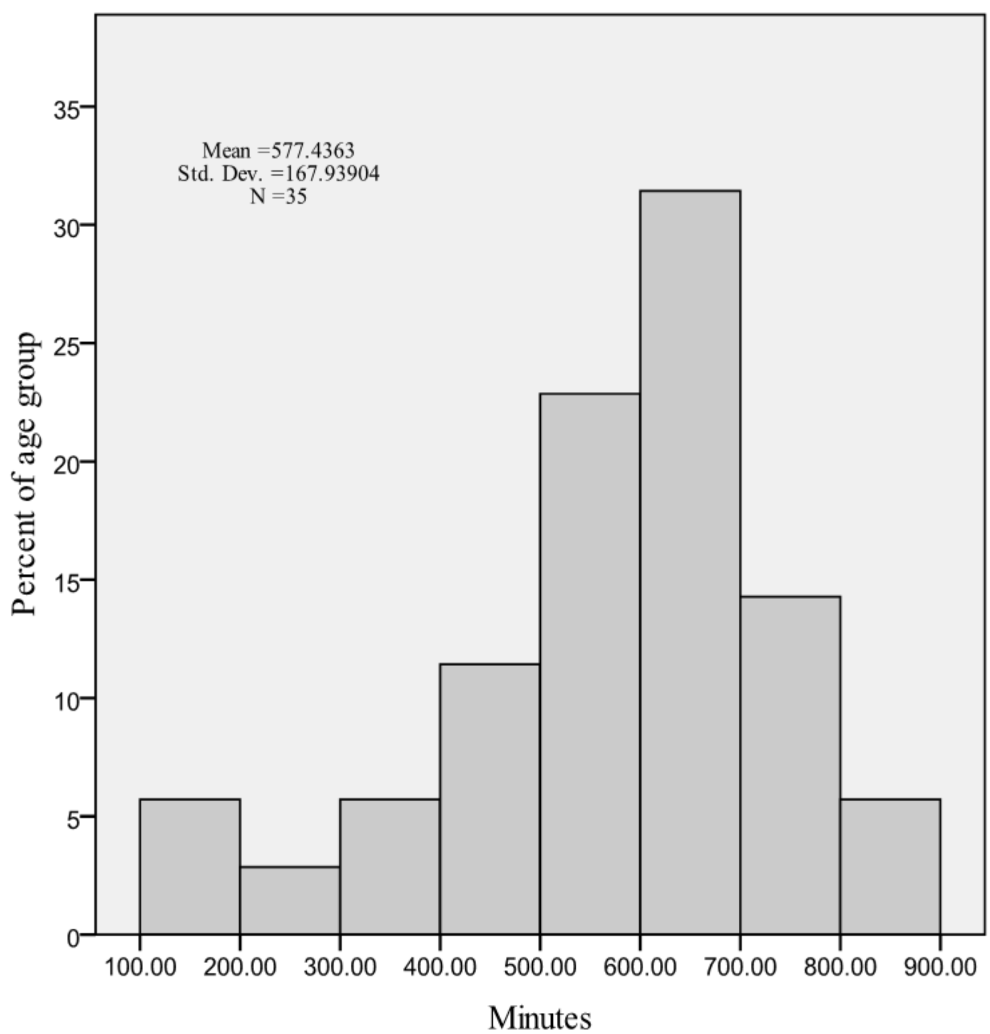
In order to determine if 10 hours (600 minutes) would include an adequate sample of Healthy Family Project children, accelerometer data from 35 Healthy Family Project children between 7 and 13 years of age were analyzed. In addition, in order to determine if there were differences the patterns of wear time between younger children and adolescents and adults, these data were compared to a random sample of adolescents and adults from the Healthy Family Project. The children wore the accelerometer between 120 and 854 minutes (2-14 hours) (Table 5.1), but on average wore the accelerometer for less than 600 minutes (10 hours) (Table 5.1). This was significantly less than the adults and adolescents used for comparison (Table 5.1).

Table 5.1. Comparison of minutes between Healthy Family Project adults and children

Age group	N	Mean minutes worn	Minimum minutes worn	Maximum minutes worn	p
Child, 7-13 years	35	577 $\pm$ 168	120	854	
Adults, 18 and over	48	724 $\pm$ 244	30	1915	
Between group differences					*0.002*

This analysis suggests that children in the Healthy Family Project had significantly less wear time than adults. In addition, the mean hours of wear time among the children was less than 10 hours (Figure 5.2).

Figure 5.2. Minutes worn by children between 7-13 years of age (n = 35**)**



These results suggest that a 10 hour (600 minute) minimum, if used, would exclude a large percentage of children from the final analysis. As a result, an 8 hour (480 minutes) minimum was used to determine whether or not data would be included in the final analysis.

Criteria for a valid accelerometer record.

A valid accelerometer record for children in this sample was defined as one that included at least 4 days of accelerometer wear and at least 8-hours (480 minutes) of accelerometer counts each wear day. The 32 children that had at least one valid accelerometer record, from either the baseline or 12-month clinic visits, were included in the analysis.

Summary measures of physical activity levels.

Physical activity level cut-points developed by Puyau et al. (2002) and subsequently used for children in rural Maryland (Treuth et al. 2005) were used for this analysis. Although, there are no standards for describing activity levels, two summary measures are commonly used in the analysis of accelerometer data: (1) cut off values for different physical activity levels such as those used in this study; and (2) METS which correspond to activity levels (Table 5.2). (A MET can be defined as the ratio of the work metabolic rate to resting metabolic rate, hence 1 MET is equal to 1 $kcal^{-}kg^{-1} \cdot h^{-1}$ or 3.5 mL $O_2 \cdot kg^{-1} \cdot min^{-}$ (Ainsworth et al. 2002).

Table 5.2. Activity level cut off points for counts per minute (Puyau et al. 2002) and METs

Counts per minute (CPM)	Activity Level	METS
<800	Sedentary	$\leq$ 1.4
800 -3199	Light	1.5 – 2.9
3200-8199	Moderate	3 – 5.9
$\geq$8200	Vigorous	>6

These summary measures are used assign counts recorded by the accelerometer, to categories of activity levels which are typically defined by activity energy expenditure in relation to resting energy expenditure. For example, sedentary activity can be defined to include activities which do not substantially increase energy expenditure above the resting level. Activities that are often defined as sedentary include sleeping, lying down, and watching television (Pate et al. 2008).

Both summary measures described here are based on calibration studies (Freedson et al. 1997; Puyau et al. 2002; Treuth et al. 2004) using regression analyses to establish cut off values for activity levels (i.e. sedentary, light, moderate, and vigorous), and identify the relationship between accelerometer counts and MET values. Typically, calibration studies (Freedson et al. 1997; Easton et al. 1998; Treuth et al. 2004) have developed these regression equations by measuring VO_2 through indirect calorimetery and accelerometer counts simultaneously. For example, Freedson et al. (1997) measured accelerometer counts and VO_2 while children and adolescents walked and then ran on a treadmill. Based on this comparison, they developed an age specific equation to predict MET values (Figure 5.3).

Figure 5.3 Freedson equation for age specific MET values (Freedson et al. 1998).

METs = 2.757 + (0.0015 x CPM*) – (0.0896 x age**) – (0.000038 x CPM x age)

**CPM = counts per minute;; **age = age in years*

Puyau et al. (2002) have developed regression equations for activity energy expenditure and activity level cut points by measuring VO_2 in both a respiration room calorimeter and through indirect calorimetery, with heart rate and accelerometer counts simultaneously. In the Puyau et al. (2002) study, 26 children engaged in sedentary (e.g. watching television, video games, arts and crafts), light (sweeping, light play), moderate (light aerobics, walking on a treadmill) and vigorous (running on a treadmill) activities while in a room calorimeter. After being measured in the room calorimeter for 6 hours, the children were escorted outside and were measured by indirect calorimetery while they jumped rope, walked, skipped, jogged and played soccer on an outdoor track.

The physical activity cut off values developed by Puyau et al.(2002) were used in this analysis because they are based on the calibration of the same model of accelerometer used in the Healthy Family Project, and include a wide range of activities measured in both a room calorimeter and on an outside surface. Likewise, the outdoor activities measured by Puyau et al (2002) are similar to those observed among the children included in this study. Cut off values derived from the Puyau et al. (2002) study have also been used in previous studies of rural children and adolescents (Treuth et al. 2004, 2005), as well as more recently in 9 to 10 year old children at risk for obesity in Newcastle and Middlesborough, England (McClure et al. 2009).

Traditionally, exercise studies have focused primarily on describing moderate and vigorous activity levels, and have been less concerned with sedentary and light activity levels;

often grouping sedentary and light activities together (Pate et al. 2008). However, there are differences between sedentary and light activity levels, and in a recent review, Pate et al. (2008) argue that sedentary and light physical activities should be treated as separate activity levels because they may have different impacts on health outcomes. Furthermore, Treuth et al. (2005) have argued for the importance of light activity in maintaining lower body fat among adolescent girls.

Because this study is concerned with describing all activity levels (sedentary, light, moderate and vigorous) among children, using a summary measure which would address both sedentary and light, as well as moderate and vigorous activity levels was important. Therefore, in order to determine which summary measures would most appropriately describe all physical activity levels a sample of accelerometer data combined with direct observations was used to compare cut off values developed by Puyau et al.(2002), MET values derived from using the Freedson equation and direct observations of sedentary, light, moderate and vigorous activities. Cut off values for the high end of moderate and vigorous activity were similar to the MET values associated with moderate and vigorous activity. However, the MET values for activity counts (e.g counts of 0 to 100) overestimated light activity, and underestimated the sedentary activities. For example, for one individual who was observed while wearing an accelerometer (Appendix 5.2), low intensity activities such as sitting, eating and watching TV produced accelerometer counts between 0 and 228. Over a 28 minute bout of sitting, eating and talking, then minimum count was 0, the maximum was 228 and the mean count was 32 (Appendix 5.2). When the counts associated with these activities were defined based on the Puyau activity level cut off values, they could all be classified as sedentary, which is consistent with the observations. However, when MET values were calculated for counts the range was 1.7 to 2.7 METs for the activities. With these values, all the activities could be defined as light activity, which for some activities, is not consistent with the observations (Table 5.3). Similarly, the minimum count for playing a game of "Duck, Duck, Goose" outside was 6 counts, or 1.7 METs. When the minimum count was recorded, the child was sitting still, yet by MET values this would be considered light activity (Table 5.3).

Table 5.3. Comparison between observations, counts, cut-points and METs.

	Observed intensity	Counts	Puyau activity levels*	MET**	MET activity levels
Sitting	Low	0	Sedentary	1.7	Light
Sitting eating	Low	4	Sedentary	1.7	Light
Standing, talking	Low	1	Sedentary	1.7	Light
Sitting (duck, duck, goose)	Low	6	Sedentary	2	Light

*Puyau et al. (2002), **Freedson et al. (1997)

Finally, the count values observed in this study are similar to counts reported for the sedentary activities reported by Treuth et al (2005) for adolescent girls, and by Stone et al. (2009) for 8 to 10 year old boys. Likewise, the MET values reported by Treuth et al. (2005) and Stone et al. (2009) for sedentary activities are lower than MET values calculated by the Freedson equation in this study. On the other hand, the cut points developed by Puyau et al. (2002) have a broader range for sedentary and light activity levels, and classify the observed sedentary activities as sedentary. Therefore, in order to get a better picture of time spent in sedentary activity as well as moderate to vigorous activity, the Puyau et al (2002) cut off points were used.

Data Analysis

Statistical tests were performed using Sigma Plot (version 11, Systat Software, Inc). Descriptive statistics were calculated by gender, ethnicity and weight status, and reported as means $\pm$ standard deviation. A t-test was used for comparisons of BMI-for-age, total activity counts, and time spent in activity levels between: 1) males and females; 2) non-Hispanic white and Hispanic children; and 3) overweight and normal weight individuals. When group data were not normally distributed, a Mann-Whitney U Rank test was also used for comparison. Seasonal differences among total activity counts and time spent in activity levels were tested using a one-way ANOVA. The relationships between BMI and total counts as well as BMI-for-age percentiles and time spent in activity levels were tested using a linear regression model. A multiple linear regression was used to model the relationship between gender, BMI-for-Age percentiles and total activity counts, as well as the relationship between gender, ethnicity, BMI-for-age and time spent in different activity levels. An alpha level of 0.05 was used for all statistical tests.

RESULTS

Sample

The sample consisted of 32 children (17 males and 15 females), with accelerometer data that met the inclusion criteria of either the baseline or 12 - month clinic visit. Twenty-six of the children had data for the 12-month visit. Six children did not have 12-month data (the accelerometer did not record or the child refused to wear the accelerometer). However, these 6 individuals had valid baseline accelerometer data and were included in the analysis (Table 5.4).

Table 5.4. Number of records from each measurement round.

	Baseline (N = 6)	12 Month (N = 26)	Total (N = 32)
% of total sample	19	81	100

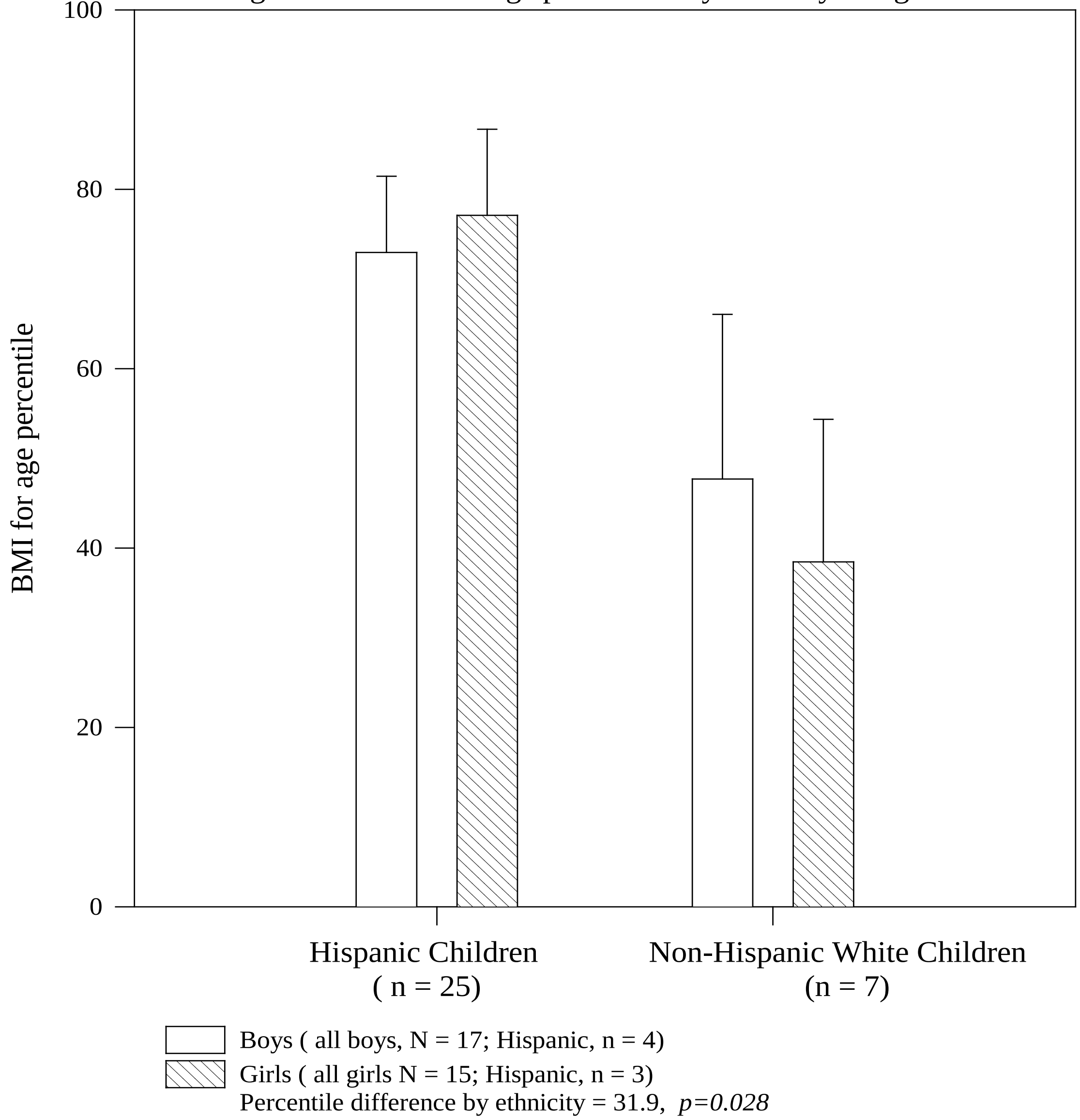
There were no significant differences in age, anthropometric measurements, weight status classification (BMI-for-age percentiles), or total activity counts between boys and girls (Table 5.5).

Table 5.5. Age, ethnicity anthropometric characteristics and total activity counts/day.

Characteristic	Boys (N=17)	Girls (N = 15)	*p*
Hispanic	82% (n = 14)	73% (n = 11)	
Non-Hispanic White	18% (n = 3)	27% (n = 4)	*0.100*
Age (years)	9.9 $\pm$ 1.1	10.5 $\pm$ 1.2	*0.198*
Weight (kg)	41.9 $\pm$ 12.5	44.1 $\pm$ 15.9	*0.658*
Height (cm)	140.4 $\pm$ 8.6	143.1 $\pm$ 11.4	*0.448*
BMI (kg/m^2)	20.9 $\pm$ 5.1	21.0 $\pm$ 5.8	*0.990*
BMI-for-Age percentile	68.5 $\pm$ 35	66.8 $\pm$ 33	*0.558*
Activity counts/day	590,334 $\pm$ 588, 365	405,797 $\pm$ 151, 374	*0.227*

Age and gender had no effect on BMI-for-Age percentile (p *=0.854)*, but when age and gender were excluded from the analysis, ethnicity had an effect on BMI-for-Age percentile. Hispanic children had higher BMI-for-Age percentile ranks than and non-Hispanic children (Figure 5.4). However, the sample size (n = 7) for non-Hispanic children was very small and the power of the test was very low (power = 0.050). Therefore, a meaningful interpretation of the relationship between weight status and ethnicity could not be made.

Figure 5.4. BMI-for-Age percentiles by ethnicity and gender.



Because of the small sample size, similarities in BMI-for-Age percentiles between boys and girls, the data were pooled into a single sample for weight status categories. When the data were pooled, almost half (47%) of the sample could be classified as either overweight or obese by BMI-for-age (Table 5.6).

Table 5.6. Weight status categories and Mean BMI –for-Age for sample

Weight Status	N	Percent of Sample
Normal weight (6th to 84th percentile)	17	53% `
Overweight (85th -94th percentile)*	3	9%
Obese (95th percentile or above)	12	38%
Total	32	100%

*Overweight (85th – 94th percentile) and Obese ($\geq$ 95th percentile) individuals were pooled for data analysis

Accelerometer Wear and Total Counts

The children wore the accelerometer for 5.3 $\pm$ 0.8 days, and on these days they wore the accelerometer for most of the day. The average number of minutes worn each day was 712 minutes, or 11.8 hours (Table 5.7)

Table 5.7. Number of valid days, average minutes of wear/day, and average total counts/day.

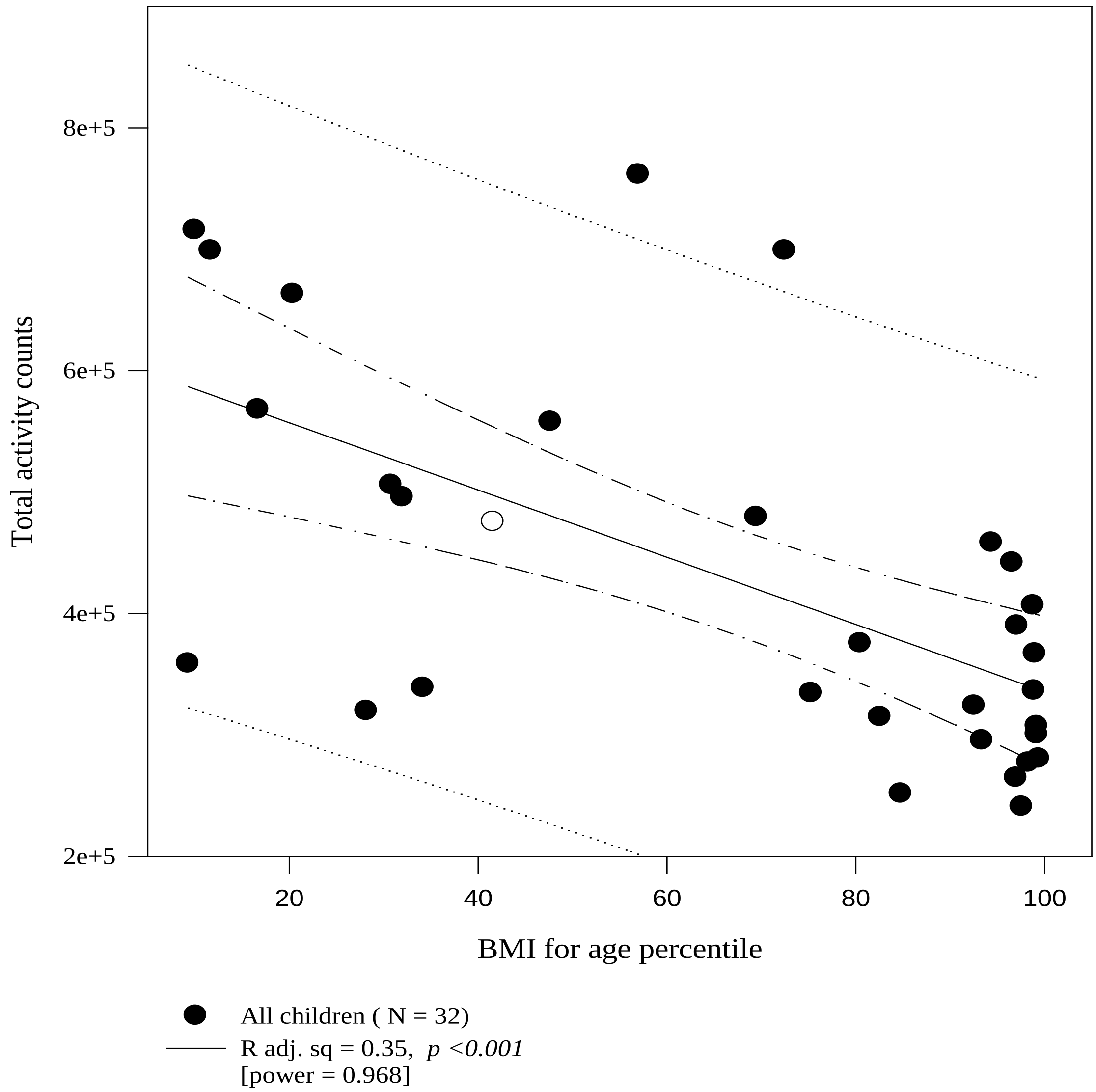
	All children (N = 32)
Valid Days*	5.3 $\pm$ 0.80
Minutes of wear /day	712 $\pm$ 79
Total counts/day	425,082 $\pm$ 151, 167

*First day of wear excluded from the analysis.

BMI-for-Age and Activity Counts

Regardless of age, gender specific BMI-for-Age percentiles, children who had a higher BMI accumulated the least number of total counts per day. Similarly, children with lower BMI accumulated higher numbers of total counts per day (Figure 5.5). These data support the hypothesis (H_1) that there is a negative relationship between BMI percentiles and total counts.

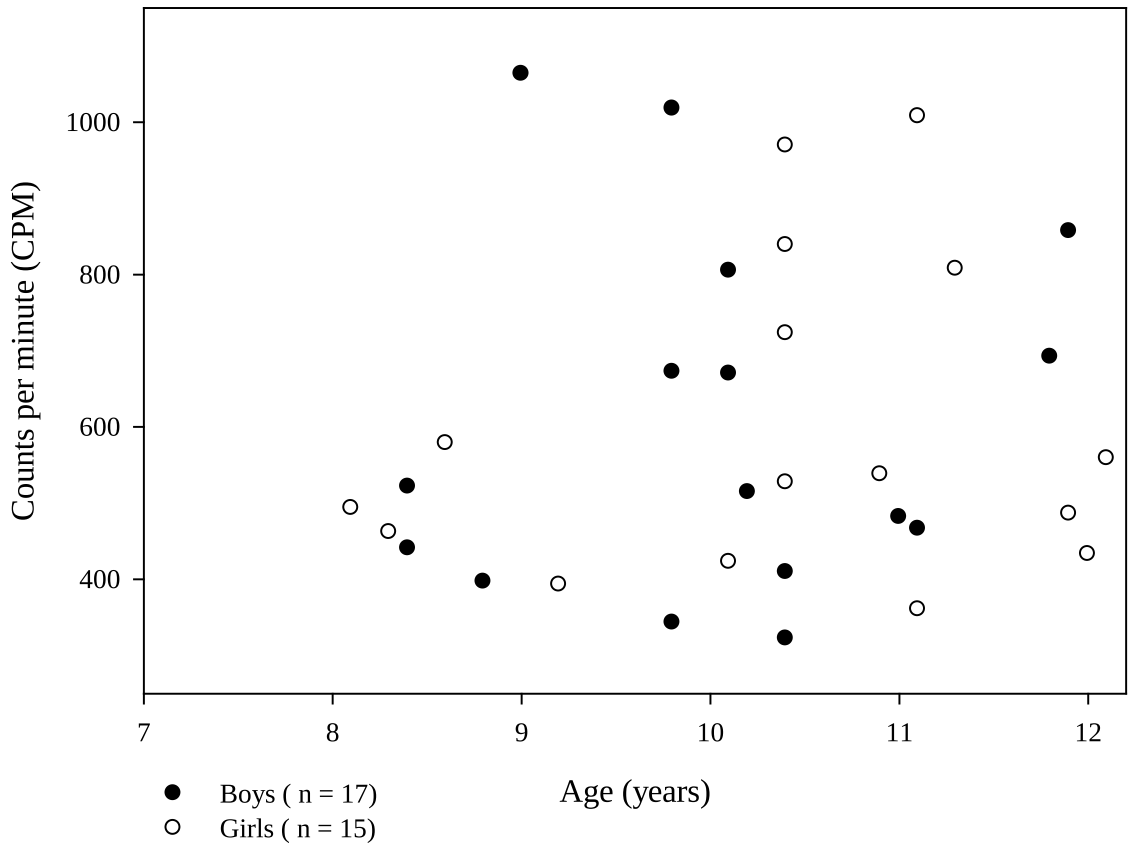
Figure 5.5. Relationship between BMI-for-Age percentiles and total activity counts.



Average Counts per minute

When the accelerometer counts were adjusted for wear time (counts per minute) and compared by age groups, there were not age-related differences in activity (Figure 5.5)

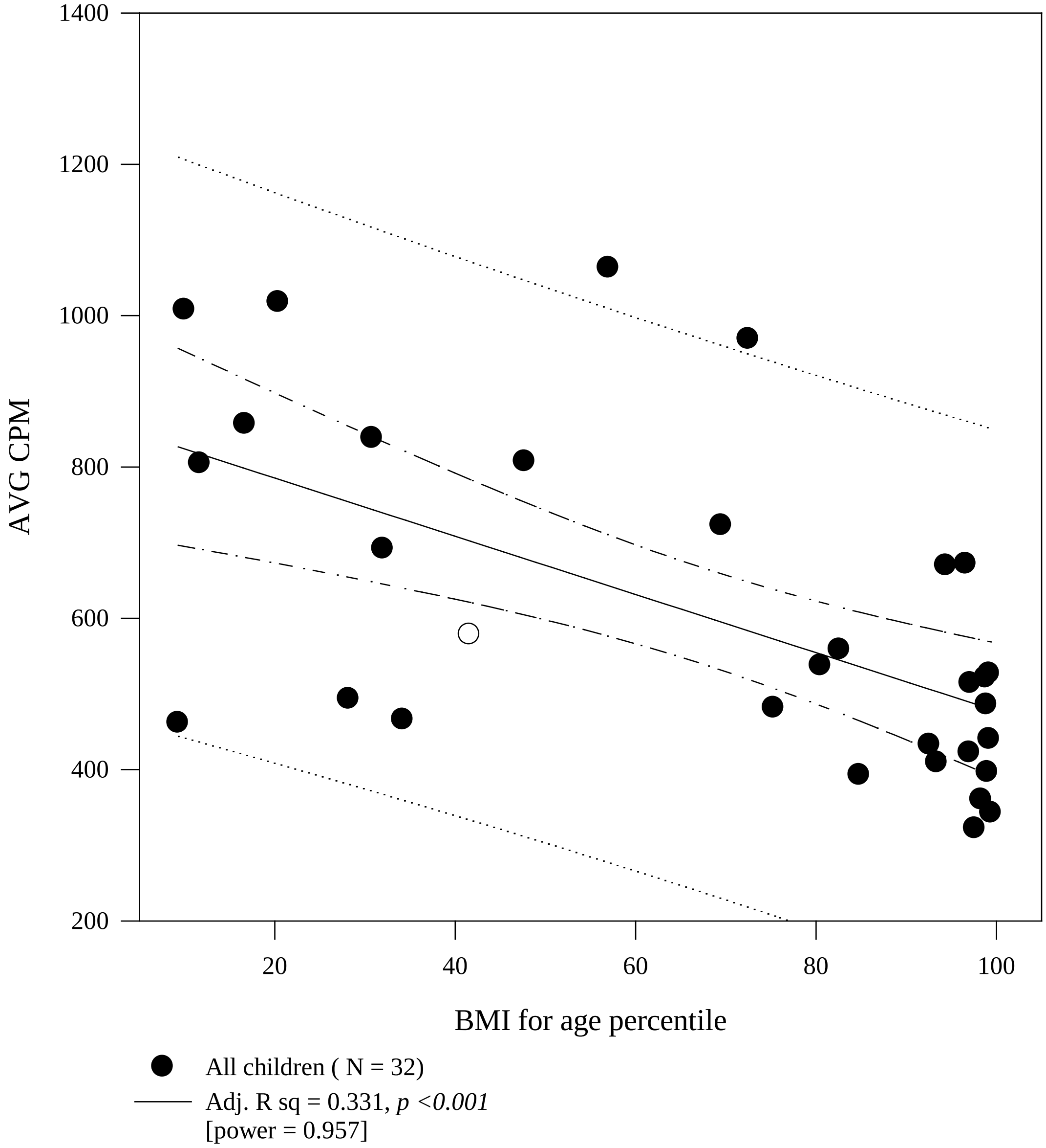
Figure 5.6. Effect of age on activity counts (counts per minute, CPM)



age = cor. coeff. = 0.137, *p = 0.457*
gender = cor. coeff. = 0.010, *p = 0.954*

When time adjusted activity counts (counts per minute) were compared by gender specific BMI-for-Age percentiles, the negative association between activity counts and BMI remained. Children with higher BMI-for-Age percentiles accumulated fewer counts per minute (CPM) than children with lower BMI-for-Age percentiles (Figure 5.7)

Figure 5.7. Activity Counts per Minute (CPM) vs. BMI-for-Age percentiles.



Similarly, children classified as normal weight had significantly higher total activity counts and average counts per minute (CPM) than overweight/obese children. Likewise, normal weight children had more variability across total counts accumulated than did at risk for overweight or overweight children (Table 5.8).

Table 5.8. Weight status classification, total counts and counts per minute (CPM)

	N	Total Counts	*p*	CPM	*p*
Normal weight (6th -84th percentile)	17	502,209 ± 164,424		718 ± 222	
Overweight/obese (≥85th percentile)	15	337,673 ± 66,046	*0.003*	470 ± 106	*<0.001**

[*t-test*, between group difference = 245; power = 0.970]

Seasonal effect on activity counts (CPM)

Children wore the accelerometer during different times of the year. Some children wore the accelerometer during the school year, while others wore the accelerometer during summer break. Although children who wore the accelerometer during summer months tended to have a slightly higher average activity count, neither the time of the year, or whether or not school was in session had a significant impact on total counts (Table 5.9).

Table 5.9. Activity counts by season and school session

	N	Counts per Minute (CPM)	*P*
Fall/Winter School Semester (August 25 – January 4)	11	580 ± 213	
Spring School Semester (January 5 – May 25)	12	590 ± 213	
Summer Vacation (May 26 – August 24)	9	644 ± 240	*0.691*

Physical Activity Levels

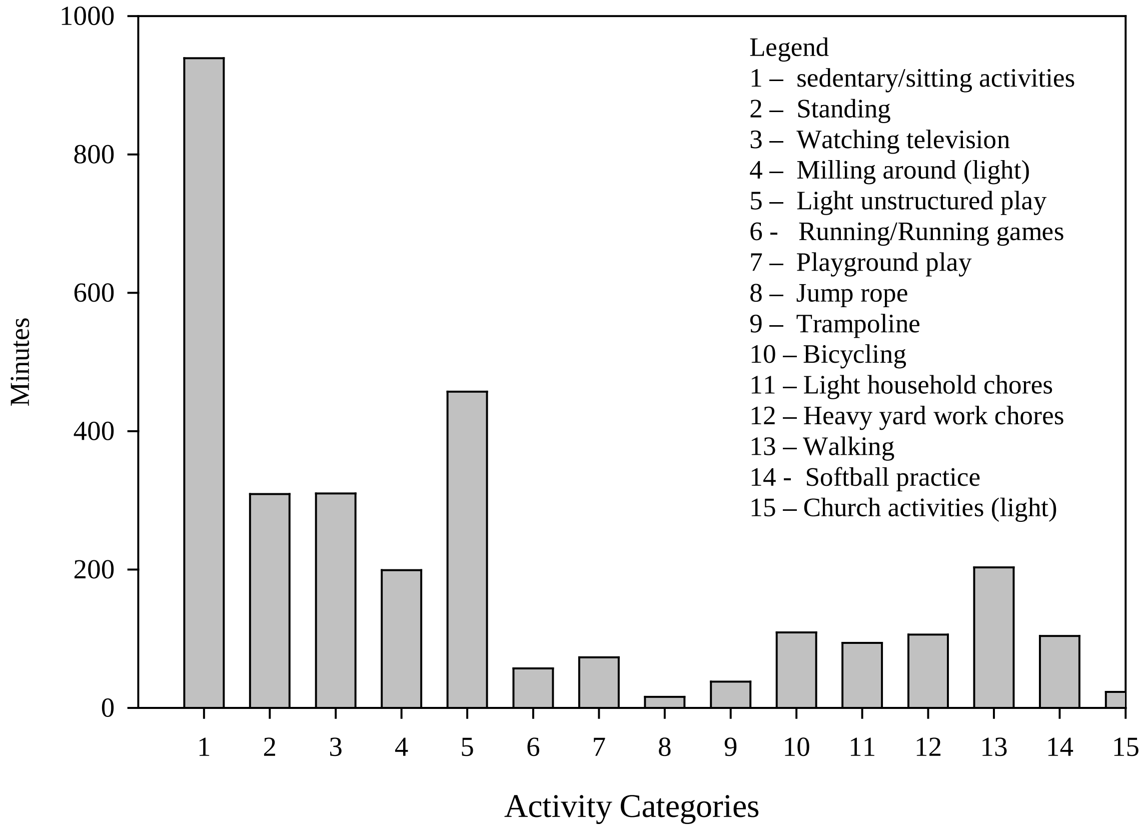
Children spent the largest percentage of their day in sedentary and light activity levels. On average, 97% of the day was spent in sedentary and light activity levels, and less than 1% of the day was spent in vigorous activity levels (Table 5.10).

Table 5.10. Minutes in different activity levels, all children (N = 32).

Activity Levels	Minutes	% of total minutes
Sedentary	549 ± 89	77.1%
Light	145 ± 45	20.4%
Moderate	16 ± 14	2.2%
Vigorous	2 ± 3	0.3%
Total	712 ± 72	100%

Similarly, children who were observed spent most of their day engaged in sedentary or light activities. Children spent 86% of their time either sitting and talking, sitting and playing board games or arts and crafts, watching television, milling around and light unstructured play or walking. The remainder of time was spent engaged in short spurts of moderate activities outside including: jumping on a trampoline, playing on playground equipment. In one case, a child spent over an hour and a half moving rocks and doing yard work. In another case, one child spent an hour and a half practicing softball. Finally, one child spent the evening at vacation bible school where she spent the larger part of the evening sitting and doing arts and crafts, watching videos and some standing and light dancing in place at the end of the evening (Figure 5.8).

Figure 5.8. Time spent in activities during observation day (N = 5)



Gender differences in Activity Levels

While there were no gender differences in activity counts, there were slight gender differences in the percentage of the day spent at moderate activity levels There was a trend towards more sedentary minutes among boys than girls (Table 5.12, Figure 5.9), and boys accumulated more moderate activity minutes than girls. (Table 5.12, Figure 5.10). However, boys also wore the accelerometer longer than girls (Table 5.12), and when wear time was controlled for, boys and girls had similar activity levels.

Table 5.11. Time spent in different activity levels by gender.

Activity Level	Boys (N = 17)		Girls (N = 15)		*P*
	Minutes	% of time	Minutes	% of time	
Sedentary	575 ± 96	77%	520 ± 72	77%	*0.085*
Light	147 ± 49	20%	142 ± 49	21%	*0.785*
Moderate	21 ± 15.1	2.8%	10 ± 10.6	1.5%	*0.037*
Vigorous	1.3 ± 1.8	0.2%	2.5 ± 4.9	0.4%	*0.557*
Total time	743 ± 78	100%	675 ± 65	100%	*0.013*

Figure 5.9. Minutes of sedentary activity by gender and BMI-for-Age percentiles.

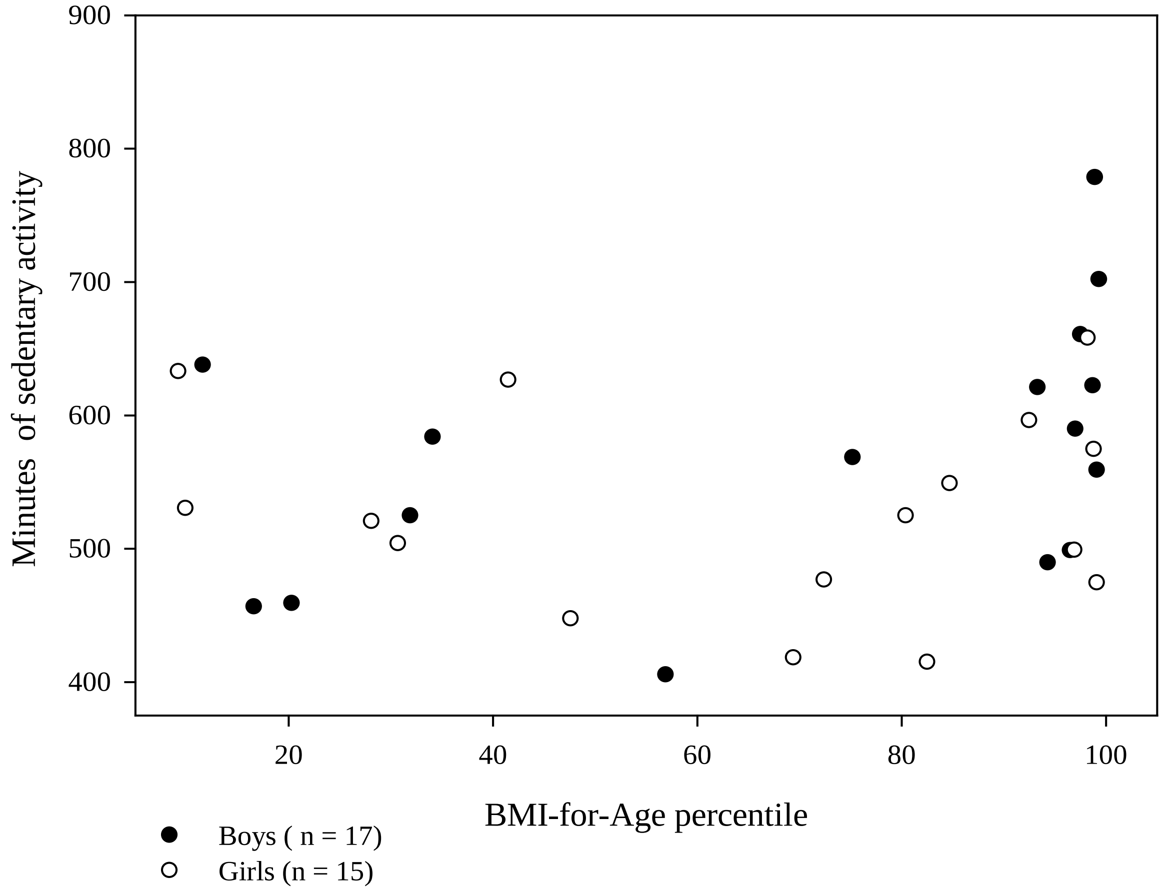
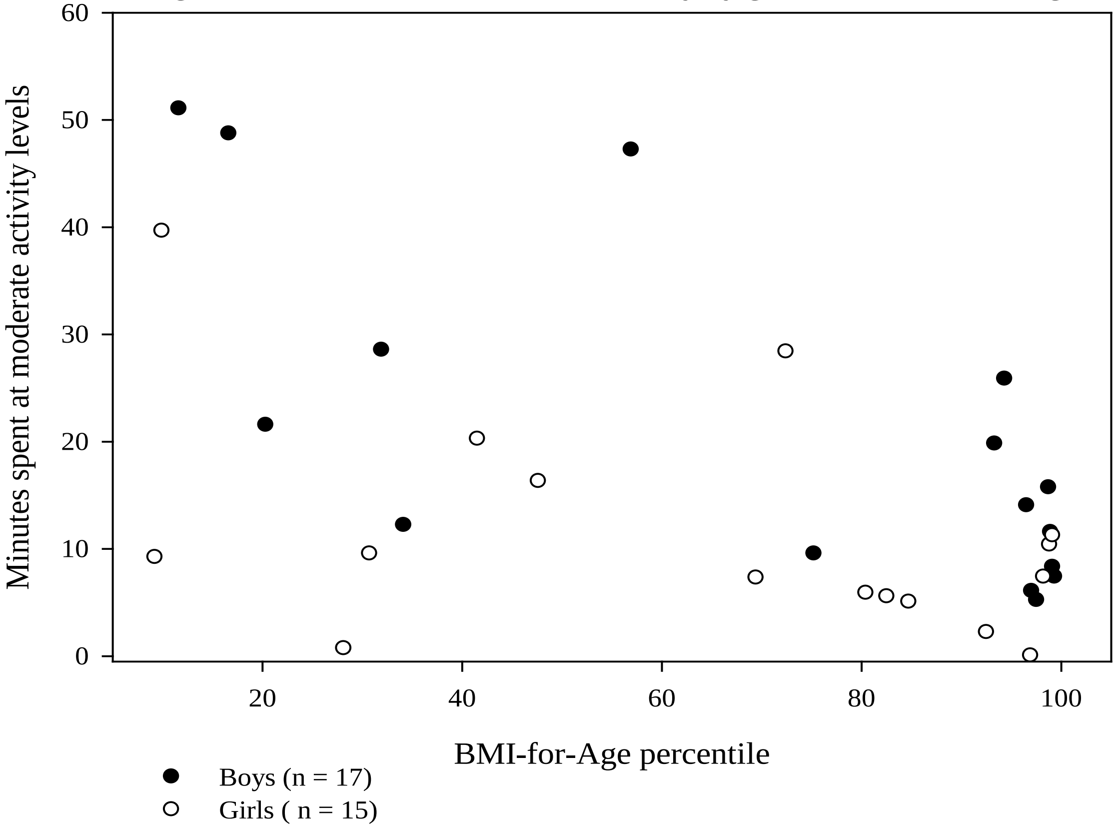


Figure 5.10. Minutes of moderate activity by gender and BMI-for-Age



Activity Levels and Weight Status

Children classified as overweight or obese spent a larger percentage of their day doing sedentary activity than children classified as normal weight (Figure 5.10). Likewise, overweight and obese children spent a smaller percentage of their day engaged in light and moderate activity than normal weight children (Table 5.12, Figure 5.11). These results support the second hypothesis (H_2): Overweight and obese children will spend more time at sedentary activity levels, and less time at light and moderate activity levels than normal weight children.

Figure 5.11. Percent of day sedentary, normal weight vs. overweight/obese.

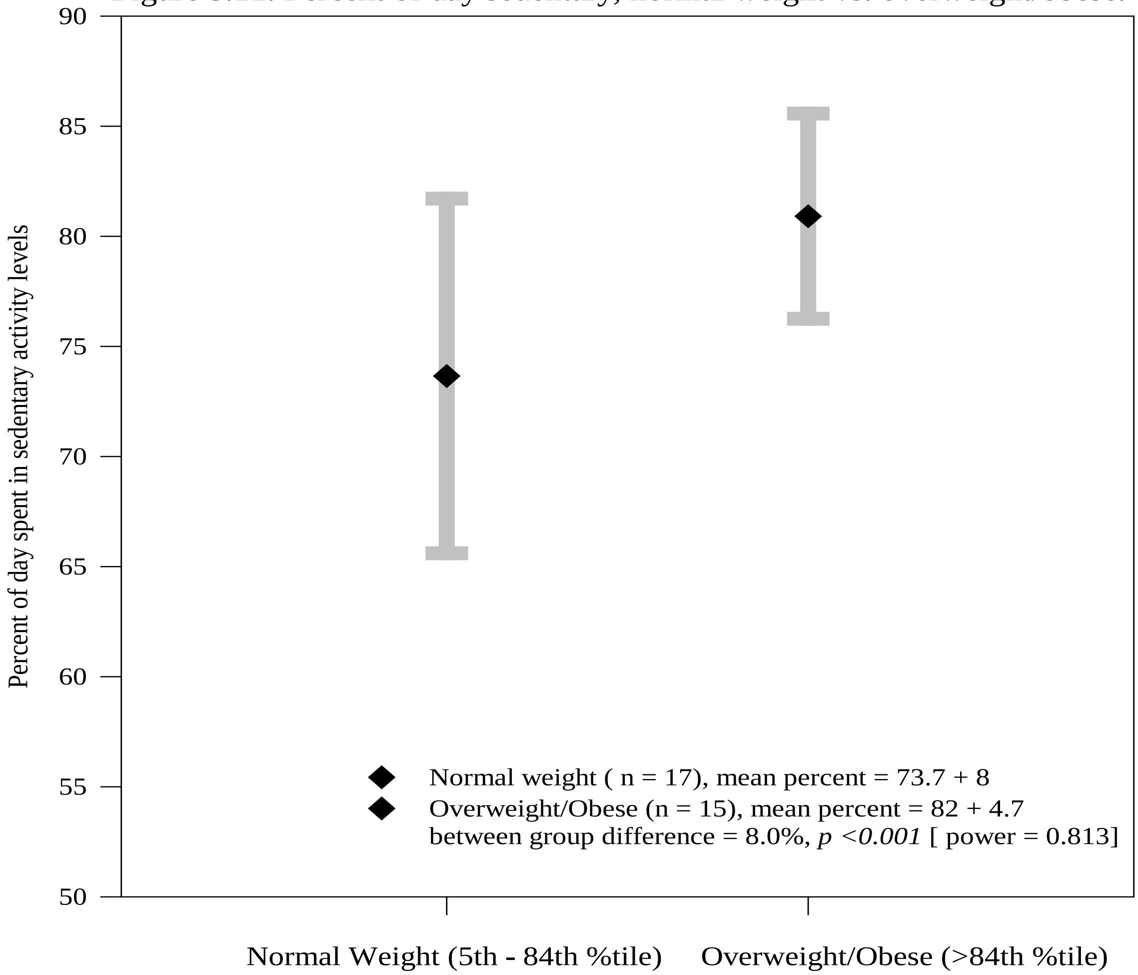
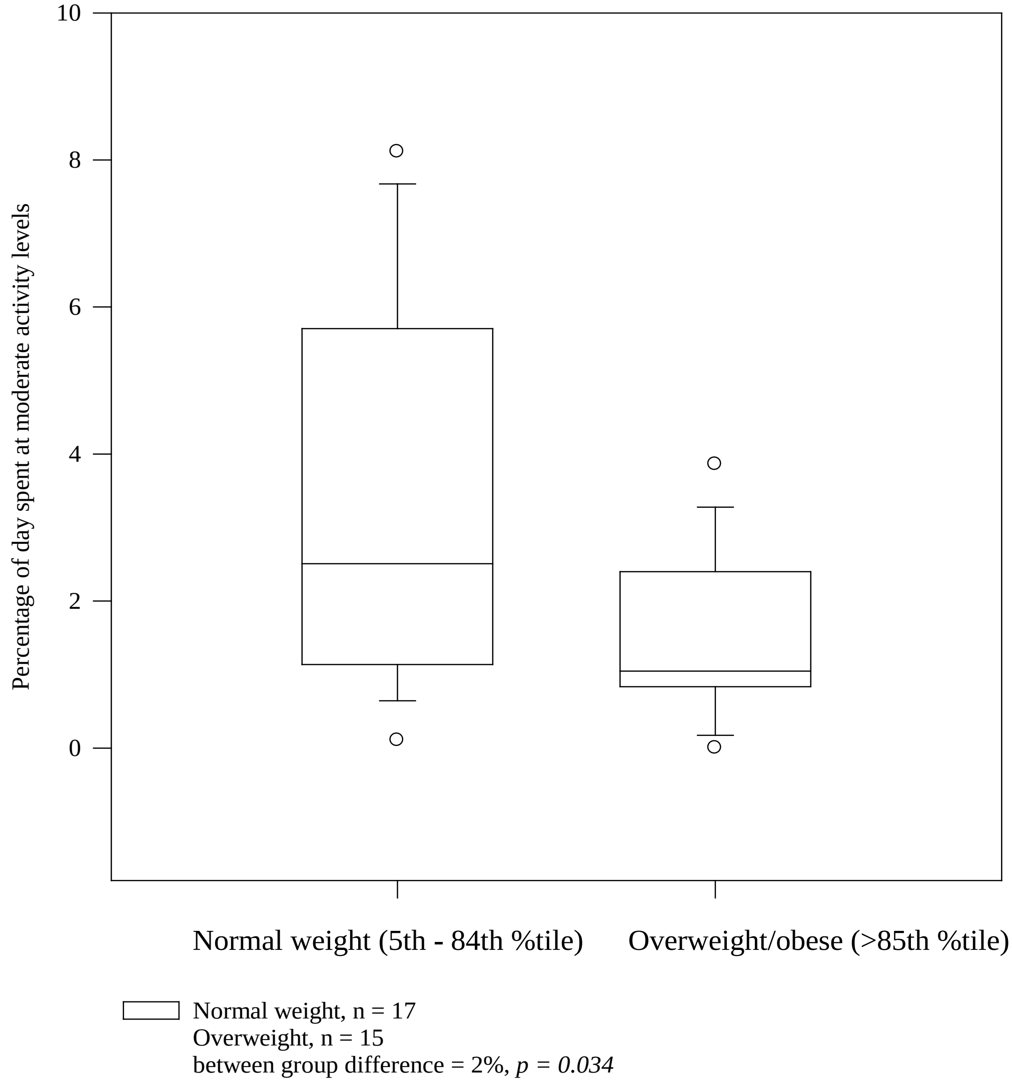


Table 5.12. Percentage of day at activity levels by weight status

Activity Level	Normal weight (N = 17)	Overweight/Obese (N = 15)	*p*
Sedentary	73.7 ± 8.0	82 ± 4.7	<*0.001*
Light	23 + 7.1	17+ 4.4	*0.015*
Moderate	3.3 + 2.5	1.5 + 1	*0.034*
Vigorous	< 1	<1	*0.197*

Figure 5.12. Percentage of day spent at moderate activity levels, normal weight vs. overweight/obese



DISCUSSION

The mean BMI of children in this study tended to be higher than the mean BMI for a nationally representative sample children between 6 and 11 years of age who participated in the accelerometer measurements through NHANES 2003-3004 (Troiano et al. 2008). Likewise, the mean BMI for this sample was slightly higher than rural children of similar ages measured in a previous study by Treuth et al. (2005). As such, almost half (47%) of the children in this study had a BMI-for-age percentile above the 85^{th} percentile, and were classified as overweight or obese. This percentage is higher than recent percentages reported for Colorado (about 25% of children are overweight) (Colorado Department of Health and Environment 2008). Moreover, the children in this sample predominantly identified themselves as Hispanic, suggesting that the pattern in this sample is similar to that previously reported, which suggests a higher prevalence of overweight among Hispanic children than non-Hispanic white children (Ogden et al. 2006).

Total activity as well as levels of physical activity may play an important role in weight status among children. In this study, BMI-for-age percentiles were negatively associated with total activity counts and counts per minute. Normal weight children spent more time in light and moderate- vigorous activity levels than overweight and obese children. Likewise, overweight and obese children spent more time in sedentary activity levels than normal weight children. These results support the study hypotheses, but are different than results in a study by Treuth et al. (2005), which did not observe differences in activity levels between normal weight and overweight rural children. The results, however, are similar to other studies which report lower levels of physical activity among overweight children. For example, Butte et al. (2007) used accelerometers to assess physical activity among 424 normal weight and 473 overweight

Hispanic children. In their study, they found normal weight children accumulated significantly more total activity counts than overweight children in the sample. Similarly, previous studies by Butte et al. (2006) and Strong et al. (2005) have also found that overweight children report lower physical activity levels than non-overweight children when controlling for gender and age. The findings in this study support previous findings which suggest a relationship between low physical activity levels and overweight among school-aged children.

Previous studies (Treuth et al. 2005, Trost et al. 2002, Troiano et al. 2008) have examined gender differences in physical activity, and report higher activity counts in elementary school boys than girls. In contrast, this study found no age or gender differences in activity counts between boys and girls, suggesting that total activity counts are not gender specific in this sample. Although, there were no gender differences in counts, there were differences in time spent in sedentary and moderate levels between boys and girls. Boys tended to spend more time in sedentary activity levels, and spent significantly more time in moderate activity levels than girls. However, boys in this study wore the accelerometer for significantly longer periods of time than girls, and when counts were adjusted for wear time, there were no differences. As such, the longer periods of time spent at sedentary and moderate activity levels among boys is a product of differences in wear time.

The lack of differences between boys and girls would suggests that within this particular age group, there are no gender differences in physical activity among children in this study. However, these results differ from previous studies which do report gender differences in physical activity. These studies have used larger sample sizes that show more variation in age differences. The sample size for study was considerably smaller, and the power for gender comparisons was below the desired power of 0.800 (power = 0.400). Furthermore, children in the sample were very close in ages. Perhaps, in a larger sample of children of different ages from this population, the results would reflect gender differences similar to those reported by other studies (Treuth et al. 2005; Trost et al. 2002; Troiano et al. 2008).

Because the children wore the accelerometer at different times of the year, activity counts and activity levels were compared by season. In this sample, there was no seasonal effect on activity counts or activity levels. These results are similar to Butte et al. (2007) who did not find seasonal differences in activity counts among Hispanic children in the United States, but are different than results reported by Rowlands et al. (2009) who reported that children in England were more active in the summer than in the winter. Likewise, other studies by Rowlands et al. (2006) and Rifas-Shiman et al. (2001) have also reported seasonal differences in physical activity among school children. The lack of seasonal differences in activity levels among children in this sample may be related to the small sample size, again the power for the comparison was below the desired power of 0.800 (power = 0.474). In a larger sample of children, there may be significant seasonal differences in activity levels.

Despite the lower statistical power, the data may represent a real lack of seasonality. Previous studies in the United States have also reported no seasonal differences, therefore, the Valley in this respect, may be similar to other regions in the United States. The lack of seasonal differences was further supported by informal observations of the available community resources and their use between 2007 and 2009 (see Chapter 1 for a detailed discussion of these observations). These observations suggest that there are similar opportunities for physical activity available year-round. Likewise, the observations also indicated that sedentary and light activities also remain the same year-round. One potential reason for this consistency could have been the year-availability of affordable community programs and open space. For example, children who were interested in sports had the opportunity to participate in sports at a reduced cost through the Alamosa Recreation Center. In the fall and winter, the center offered basketball, volleyball and football program. In the spring and summer, soccer, and gymnastics programs were also available. Children did not have to live in Alamosa participate, and the programs drew some children from other towns such as Monte Vista, La Jara, Sanford and Center.

For children who were not interested in sports, but wanted to play outside, each town had a city park, and park use was observed year-round. For example, although there was snow and cold weather during the winter months, children were sometimes seen playing in the city parks on snowy weekends.. During the summer months, there were always children and adults using the parks. For example, in Alamosa, Cole Park is the largest park. A popular lunch break activity for adults was to walk on the path surrounding the park. Every day, adults were observed walking on the path. The park had a small playground and during the summer; it was always full of children. The park also had a number of covered picnic areas with barbeque grills; these areas were popular for family gatherings as well as company picnics in the spring. Children and families also gained access to playground and park areas when two of the elementary schools in the Valley were awarded *Great Outdoor Colorado Local Government* improvement grants (GOCO.org) to fund the construction of new playgrounds. To offset some of the construction costs, these communities also held fundraisers for the playgrounds. As a result, the playgrounds were made available to the community members to use when school was not in session

In addition to city parks, the local Boys and Girls Club in Alamosa was open year-round, and was a popular place for working parents to send their children. During the school year, the Alamosa County school bus made a stop at the Boys and Girls club. In the summer, parents would drop their children off at the club. In addition to a new playground built in 2008, the club offered activities and programs that required less physical activity (e.g. arts and crafts). On at least two visits to the Boys and Girls club (1 school year, 1 summer), there were both children outside on the playground and inside working on arts and crafts projects. A few children were also observed doing homework in the commons area of the club.

Finally, school schedules did not have marked seasonal changes; therefore, physical activity pattern during the school year should not have varied. Schools were visited during both the cold winter months and the spring months; PE classes and recess schedules did not change from the fall to spring. Furthermore, in at least 2 schools, recess was held outside regardless of snow or colder temperatures.

The accelerometer data, previous studies in the United States, and observations made within the community, all suggest a lack of seasonality in physical activity among children in the Valley. On the other hand, previous studies in England (Rowlands et al. 2006; 2009; Rifas-Shiman et al. 2001) suggest that there is some seasonality among children. These differences may be related to school polices, availability of community resources, as well as the way physical activity data has been collected. Schools in England may change recess and PE schedule during the school year. In addition, sports, or community clubs like the Boys and Girls Club may not be available on a year-round basis. Finally, some studies which report a seasonal effect on activity levels are not based on objectively measured data, but rather self-report data (Rifas-Shiman et al. 2001). Therefore, the seasonal differences observed in the Rifas-Shinam study (2001) may be related to overestimation or underestimation of activity levels by the respondents. Nevertheless, identifying seasonal changes in physical activity is important and something that deserves further research among children in the San Luis Valley.

While there were no age, gender or seasonal differences in activity levels, there were physical activity differences related to weight status. When activity levels were compared by weight status, overweight and obese children spent significantly more time in sedentary activity levels, and less time in light and moderate-vigorous activity levels than the normal weight children. Unlike the differences in activity levels observed between boys and girls, these differences were not related to total wear time; both groups wore the accelerometers for about the same amount of time. Moreover, when activity counts were adjusted for wear time, the results were the same. Again, these results are similar to those reported by Butte et al. (2007); Butte et al. (2006) and Strong et al. (2005) who have reported lower activity levels among overweight children. Furthermore, these results support the second hypothesis tested: weight status is negatively associated with time spent in moderate-vigorous activity levels.

Although normal weight children spent more time in moderate-vigorous activity levels than overweight and obese children, they still spent the largest percentage of their day in sedentary and light activity levels. In fact, all children in this sample spent the largest percentage (97%) of their time in sedentary or light activity levels, with normal weight children spending more time in light and less time in sedentary activities than overweight or obese children. These data are similar to Butte et al. (2007) who reported that children in their sample, regardless of weight status, spent 90% of their waking hours engaged in sedentary or light activities. Similarly, Treuth et al. (2005) reported that children in their sample spent the largest part of their days in sedentary or light activity levels (92%). Given the large percentage of time spent in light activities among children in this and other studies, as well as the significantly higher amount of time spent in light activity among normal weight children in this study, light activity may also play an important role in children's energy balance.

Children in this sample spent the lowest percentage of their time engaged in moderate and vigorous activity, and on average, did not meet the recommendations of 60 minutes or more of moderate-vigorous activity (US Department of Health and Human Services 2008). While normal weight children did accumulate significantly more minutes of moderate-vigorous activity than overweight or obese children, it was still lower than recommendations, suggesting that in addition to moderate-vigorous activity, light activity may also be an important aspect of the ability to maintain a healthy weight. Furthermore, Treuth et al (2005) have argued for the importance of light activity in decreased body fat and BMI among rural girls. In their study, time spent in light activity was significantly correlated with lower percentage of body fat. Likewise, in this study, light activity may be a mitigating factor in maintaining normal weight status among children.

The large percentage of time spent in sedentary and light activity levels is further supported by direct observations of children. In addition, observations which were conducted with a child wearing an accelerometer, as well as those without an accelerometer indicate that children accumulate bouts of moderate to vigorous activity differently than adults. Rather than continuous bouts of moderate-vigorous activity (e.g. exercising on a treadmill or stationery bike), children accumulate moderate-vigorous activity in short intervals (e.g. running across the playground to get to a slide).

Children in the observation subsample spent 86% of the observation day engaged in sedentary or light activities, only slightly less than the larger sample of children measured with accelerometers. These children spent large blocks of time sitting, milling around (no specific activity), standing around and engaging in light unstructured play. While these children engaged in mostly sedentary and light activities, they also engaged in very short bursts of moderate-vigorous activities throughout the day. The patterns of activity observed in this subsample suggest that the 1-minute epochs of the accelerometers may not have picked up all of the light, moderate and vigorous activities in the larger sample of children, as children change their activities quickly. These data also suggest that unlike adults, who usually accumulate moderate-vigorous activity in sustained bouts, children accumulate moderate-vigorous activity in short bursts. Among the children who were observed, bouts of vigorous activity were obtained in short spurts, such as running across the yard, and then standing still for a few minutes. When these children played at the playground they would run between play structures, stop for a few minutes, and then run across the play structure again, or climb on the play structure, and then hang on it for a few minutes.

Another example of rapid changes in activities is in how children played outdoor games and used home play equipment. When children were observed playing outdoor games, they were tag-like games, where they would run for a minute or two, and then stop for several minutes, then walk around, and then run again. After several minutes of one game, children would often walk to another part of the yard or house and start another activity. Another example of this pattern was among two children who had access to trampolines. In these cases the children would jump on the trampoline for one or two jumps, and then stand still or sit down and talk with their friends or siblings for a few minutes.

The observations further highlight the important role in light activity among children's daily physical activity, as well as the importance of setting accelerometers to shorter epochs in children's studies. Children who were observed spent a large part of their day engaged in sedentary and light activities, especially in unstructured play. This pattern is similar for children who did not wear an accelerometer during the observations as well as those who did. The accelerometer data for the larger sample of children in the study also indicate higher levels of light activity.

Finally, both the observations and the one-two minute peaks in activity counts within the accelerometer data, indicate that the children changed their activity levels quickly, and accumulated bouts of physical activity in very short bursts. These results are consistent with changes in accelerometer designs, and newer models can be set to shorter epochs (5, 10, 20, 30 seconds) to address shorter bouts of physical activity. Some, more recent studies have used these shorter epochs with children; however, these studies have primarily focused on younger (2-5 year olds), pre-school children rather than older (6-12 year olds) elementary school aged children (Vale et al. 2009; Pate et al. 2006). Therefore, the results presented in this study are important in that they are consistent with studies that advocate shorter epochs, and can inform future studies in choosing the most appropriate accelerometer to measure older children's physical activity levels.

Finally, the observations also highlight the importance of including more detailed activity diaries, or direct observations in studies where children are wearing accelerometers. While accelerometers are an excellent tool for measuring movement among free-living children, they do have some limitations. First, when set at 1-minute epochs, they may not record quick changes in activity levels, but newer models of accelerometers address this issue. Second, they are less accurate in picking up movements during bicycling than walking or running. It is important to note here that two children in the ethnographic study were observed riding bicycles. These two children were not wearing an accelerometer on the day that they were observed riding their bikes, and the activity was only recorded because an observer was present. If these children would have only been wearing an accelerometer (no observer present), the bicycling might not have been recorded, and their activity levels would have been underestimated.

Although the children in this study had relatively low physical activity levels and did not meet recommendations for healthy physical activity levels, children in particular school districts tended to have higher physical activity levels. Fourteen of the children in this sample attended a school which was either an intervention or control school included in the School Environment Project study. Some of the study schools had implemented policy changes directed at increasing physical activity opportunities, while others had not. Regardless of school policy changes (observed during the current study) and intervention status of the school (intervention or control school), attendance at school participating in School Environment Project tended to be associated with lower BMIs and higher physical activity levels. Children who attended School Environment Project schools tended to have lower mean BMI-for-Age percentiles than those who attended non School Environment Project schools (58.4 ± 32 and 75.9 ± 33 respectively). Likewise, children who attended a School Environment Project school tended to spend less time in sedentary, and more time in moderate-vigorous activity levels (521 ± 99 and 21±16 respectively) than non-School Environment Project schools (571 ± 76 and 16 ± 16 respectively). Although a very small sample of children from School Environment Project schools, were represented in this study, and the School Environment Project was in place prior to the current study, these results may suggest the importance of the School Environment Project's role in helping children in the San Luis Valley maintain a healthy weight, and engage in healthy levels of physical activity. Perhaps a study with a larger sample of children representing both School Environment Project (both intervention and control schools) and non-School Environment

Project schools would provide more insight into the project's role in weight status and physical activity among children.

Finally, this study is limited by its small sample size in comparison to previous studies which have measured physical activity among children (Treuth et al. 2005; Butte et al. 2007; Troiano et al. 2008). Despite this limitation, this study used both ethnographic data and objectively monitored data to provide a glimpse into the daily physical activity patterns of children living in rural Colorado, and can be used to develop future projects directed at understanding the role of physical activity in rural children's energy balance. Two promising directions for future projects would be a similar study which uses accelerometers and observations to examine seasonal effects on physical activity among a larger sample of children, and/or one which uses both observations and accelerometers to compare physical activity between children attending School Environment Project schools and those who are not.

CONCLUSION

The results of this study support both of the hypotheses that were tested, and indicate an association between low physical activities and obesity among children. The results of this study are consistent with results reported by Butte et al. (2007), who reported lower activity levels among overweight children. The results reported here are also consistent with previous reports by Treuth et al. (2005) who suggest that light activity, in addition to moderate-vigorous activity, may play an important role maintaining a healthy weight in children. Finally, the results of my observations highlight the importance of using shorter epochs for accelerometer studies with children, as well as the importance of more detailed activity diaries or direct observation in understanding children's daily physical activity patterns.

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CHAPTER VI:

CHANGES IN WEIGHT AND PHYSICAL ACTIVITY AMONG 7-12 YEAR OLDS PARTICIPATING IN THE SAN LUIS VALLEY HEALTHY FAMILY PROJECT

INTRODUCTION

With improvements in activity monitoring devices, such as accelerometers, physical activity among children can be assessed with less reporting bias than self-report surveys, and can provide information about physical activity among free living children over multiple days. However, few, if any, studies have used accelerometers to assess longitudinal changes in physical activity among elementary school children, especially children living in rural parts of the country. The San Luis Valley is a rural region in Colorado where obesity and chronic disease have been of interest to researchers. The San Luis Valley Healthy Family Project was a longitudinal, randomized control study designed to look at the effectiveness of home-based lifestyle coaching on families who were at risk for type II diabetes. In order to assess physical activity, families were asked to wear an accelerometer at the beginning and the end of the study. Because the study included all family members, including elementary school aged children; it provided an opportunity to examine longitudinal changes in physical activity patterns among children, as well as examine the relationship between weight status, weight changes and physical activity levels.

The purpose of this study is to: 1) assess longitudinal changes in physical activity among elementary school children from families participating in the Healthy Family Project; 2) assess the relationship between weight changes and changes in physical activity over a 12 month period. Because children were participants in a study with an intervention component, it is expected that there will be changes in physical activity levels between the first and last measurements. Likewise, it is expected that children who are physically active and/or meet physical activity recommendations, will remain weight stable (relative to age and gender specific growth percentiles), or lose weight over the 12-month period. Based on these expectations, the following hypotheses were tested in this study:

> H_1: Children will have higher total counts and more minutes of moderate-vigorous activity at the 12 month measurement than at the Baseline measurement.
>
> H_2: Children with who have greater increases in BMI will have lower levels of physical activity at 12 months than children will lower increases in BMI.

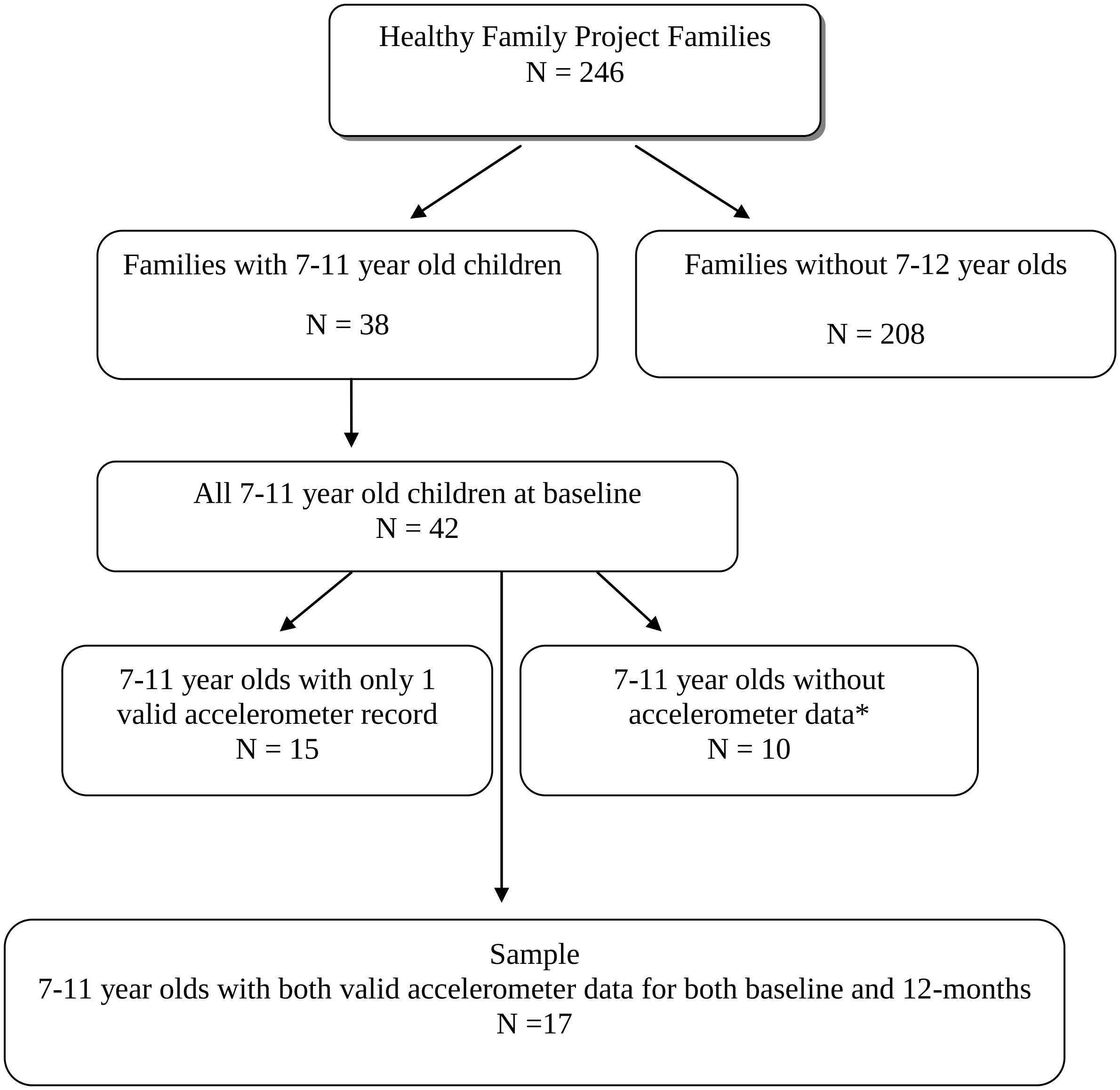
METHODS

Participants

Participants were 17 children between 7 and 12 years of age from families participating in the San Luis Valley Healthy Family Project, a 12 month, randomized control study designed to test the effectiveness of home-based lifestyle coaching on dietary intake, physical activity patterns and weight status. Families participating in the Healthy Family project were scheduled for 3 clinic visits (baseline, 6 months, and 12 months) over the 12 month period. Each visit included a series of anthropometric measurements (height, weight, waist circumference and blood pressure) an interview which included questions about diet, physical activity, health care, and community resource use, and a 24-hour dietary recall during the baseline and 12-month visits. In addition, families were asked to wear an accelerometer for the 7 days following their baseline and 12 month clinic visits.

A total of 246 families participated in the study; 38 had children between 7 and 11 years of age at baseline, and 17 children from these families wore the accelerometer for a minimum of 4 days following both their baseline and 12-month clinic visits (Figure 6.1). Of these 17 children, 9 were from families which received home-based lifestyle coaching prior to the 12-month measurement. Written informed consent was signed by all participating adults in the family, and assent forms were signed by all participating children. All research was approved by Colorado Multiple Institution Research Board.

Figure 6.1. Sample selection from the San Luis Valley Healthy Family Project



**child did not wear accelerometer, or accelerometer was malfunctioning during the 7-day wear period.*

Anthropometry

Height and weight measurements were collected during baseline, 6-month and 12-month clinic visits for the Healthy Family Project. Height was measured to the nearest 0.10 cm using an Accustat stadiometer (Genetech Inc.). Weight was measured to the nearest 0.5 kilogram using a balance scale. BMI was calculated as weight (kg) / height (m^2), and age and gender specific BMI percentiles were calculated using the Centers for Disease Control and Prevention BMI-calculator tool (Centers for Disease Control and Prevention 2009). Weight status was classified by BMI-for-Age percentiles, following guidelines by Barlow et al. (2007). Children who had a BMI-for-Age that fell between the 5^{th} and 84^{th} percentile were classified as normal weight. Those who had a BMI-for-Age between the 85^{th} and 94^{th} percentile were classified as overweight, and those with a BMI-for-Age over the 95^{th} percentile were classified as obese.

Measurement of Physical Activity

Physical activity was measured using an Actigraph 7164 (Actigraph, Ft. Walton Beach, Fl) accelerometer. The Actigraph 7164 accelerometer is a uniaxial activity monitor that detects limb movements within a 0.5-7-Hz frequency range, and filters out high frequency vibrations such as riding in a car or a lawn mower. Accelerations in movement are recorded as counts in 1 minute cycles (i.e. epochs) (MTI Health Services, FT. Walton Beach FL).

Participants were asked to wear the monitor during waking hours for 7 consecutive days following their baseline visit, and then again for 7 consecutive days following their 12-month clinic visit. If an individual skipped a day during the 7-day wear period, he or she was instructed to wear the accelerometer for an additional day immediately after the 7-day period. Seventeen of the children from the 38 families wore the accelerometer as instructed at both baseline and 12-months.

In addition to wearing the accelerometer, all participants were to record the time that they put the accelerometer on in the morning, and the time that they took it off in the evening. Participants were also asked to record any time that they removed the accelerometer for 15 minutes or more, and record any extra days that they wore the accelerometer.

Data Reduction

After being worn, accelerometers were downloaded and saved on a clinic computer using Actisoft software (version 3.1.1). The files were then analyzed for valid days and minutes using the Actisoft software (version 3.1.1) Following previous recommendations for accelerometer analyses (Trost et al. 2004; Masse et al. 2005), and criteria which would include the largest sample size (see Chapter 5 for discussion of inclusion criteria); files which had a minimum of 4 days with 8 hours of wear time were considered valid files and used in the analysis. In addition, the accelerometers were initialized to start recording at 8am on the first day, however, many participants reported wearing the accelerometer before 8am. In order to adjust for the potential loss of activity data, the first day of wear was excluded from the analysis.

Only children who had accelerometer files which met the inclusion criteria for both the baseline measurement and 12-month measurements were included in this analysis. Both the baseline and 12-month files were analyzed to identify total activity counts per day, average activity counts per day, and time spent in: sedentary, light and moderate to vigorous activity levels.

Summary measures of physical activity levels.

Physical activity level cut off values developed by Puyau et al. (2002), and subsequently used for children by Treuth et al (2004, 2005) and McClure et al. (2009) were used to describe activity levels among children in this sample (Table 6.1)

Table 6.1. Activity level cut off points for counts per minute (Puyau et al. 2002)

Counts per minute (CPM)	Activity Level
<800	Sedentary
800 -3199	Light
3200-8199	Moderate
$\geq$8200	Vigorous

These physical activity cut off values were used in this analysis because they are based on a calibration study by Puyau et al. (2002) which developed regression equations for activity energy expenditure and activity level cut points by measuring VO_2 in both a respiration room calorimeter and through indirect calorimetery, with heart rate and accelerometer counts simultaneously. In the Puyau et al. (2002) study, 26 children engaged in sedentary (e.g. watching television, video games, arts and crafts), light (sweeping, light play), moderate (light aerobics, walking on a treadmill) and vigorous (running on a treadmill) activities while in a room calorimeter. After being measured in the room calorimeter for 6 hours, the children were escorted outside and were measured by indirect calorimetery while they jumped rope, walked, skipped, jogged and played soccer on an outdoor track.. The calibration study by Puyau et al. (2002) also used an Actigraph 7164 accelerometer and included a wide range of activities measured in both a room calorimeter and on an outside surface. Furthermore, the outdoor activities measured by Puyau et al (2002) are similar to those which have been observed among children in this sample. Finally, the cut off values derived from the Puyau et al. (2002) study have also been used in previous studies of rural children and adolescents (Treuth et al. 2004, 2005), as well as more recently in 9 to 10 year old children at risk for obesity in Newcastle and Middleborough, England (McClure et al. 2009).

Data Analysis

Statistical tests were performed using Sigma Plot (version 11, Systat Software, Inc). Descriptive statistics for baseline and 12 month age, weight, height, BMI, BMI-for-Age percentiles, activity counts, and time spent at various activity levels were reported as means $\pm$ standard deviation. Activity counts were summarized as counts per minute (CPM) in order to control for wear time differences between children. A t-test was used to test gender differences in weight, height, BMI-for-Age percentiles, activity counts, and time spent at different activity levels. When a sample failed the normality test, a Mann-Whitney U test was used in place of the t-test.

Repeated measures were used to test for changes in weight, height, BMI-for-age percentiles, activity counts, and minutes spent at sedentary, light and moderate-vigorous activity levels. The difference between baseline and 12-month weights (kg) and BMI-for-Age percentiles were calculated to measure amount of change for each individual, and a linear regression model was used to test the relationship between change in weight and BMI and activity counts. An alpha level of 0.05 was used for all statistical tests.

RESULTS

Sample

The sample consisted of 17 children (11 males and 6 females), each of whom had anthropometric data and valid accelerometer records at both the baseline and 12- month clinic visits. When both the baseline and 12 month measurements were compared, there were no significant differences in weight, height, BMI, BMI-for-Age percentiles and activity counts per minute (CPM) between boys and girls (Table 6.2, Table 6.3). However, there was a trend towards longer wear time among girls at the 12 month measurement.

Because there were no significant differences between boys and girls, and the small sample size reduced the power for comparisons between gender, all children were grouped together for the longitudinal analysis of changes in weight and physical activity.

Table 6.2. Baseline anthropometric and accelerometer characteristics for boys and girls.

	Boys (N = 11)	Girls (N = 6)	p^*
Weight (kg)	37.6 ± 11.6	34.5 ± 11.6	*0.613*
Height (cm)	136 ± 6.5	132 ± 8.5	*0.298*
BMI- (kg/m^2)	20.1 ± 4.6	19.5 ± 4.6	*0.793*
BMI-for-Age percentile	70.1 ± 35.3	65.9 ± 36	*0.580***
Minutes of wear/day	703 ± 91	718 ± 78	*0.719*
Counts per minute (CPM)	689 ± 183	617 ± 73	*0.371*

*power is below the desired power of 0.800, power = 0.050; **Mann-Whitney U statistic

Table 6.3. 12-month anthropometric and accelerometer characteristics for boys and girls.

	Boys (N = 11)	Girls (N = 6)	*p*
Weight (kg)	43.8 ± 13.9	40.1 ± 15.5	*0.657*
Height (cm)	142± 0.1	138 ± 0.1	*0.280*
BMI (kg/m^2)	21.2 ± 5.2	20.7 ± 5.4	*0.829*
BMI-for-Age percentile	68.4 ± 38	67.3 ± 31	*0.841*
Minutes of wear/day	668 ± 66	737 ± 59	*0.052*
Counts per minute (CPM)	603 ± 224	562 ± 183	*0.711*

As expected for normal growth, the children in the sample showed increases in weight, height, and BMI. However, there were no significant differences for BMI-for-Age percentiles, or the number of days or minutes of accelerometer wear between the baseline and 12 month measurement rounds (Table 6.4). Although there were no differences in the number of days or minutes of accelerometer wear, there was a tendency for activity levels to decrease from the baseline measurement to the 12 month measurement; activity counts per minute decreased by 76 counts (Table 6.4).

Table 6.4. Changes in anthropometric and accelerometer characteristics, all children (n = 17)

	Baseline	12 Month	Difference	*p*
Age	9.2 ± 0.969	10.3 ± 0.982		
Weight (kg)	36.5 ± 11.3	42.6 ± 14.0	6.1 ± 3.8	< *0.001*
Height (cm)	134.3 ± 0.073	140.8 ± 0.079	6.5 ± 1.7	< *0.001*
BMI (kg/m^2)	19.9 ± 4.47	21.0 ± 5.13	1.1 ± 1.4	*0.004*
BMI-for-Age percentile	68.7 ± 34.8	68.0 + 35.2	0.7 ± 8.6	*0.755*
Days of wear	5.8 ± 0.562	5.4 ± 0.80	0.4 ± 0.86	*0.111*
Minutes of wear/day	713 ± 80	713 ± 71	--	*0.999*
Activity counts (CPM)	664 ± 154	588 ± 205	76 + 51	*0.138*

Intervention status and activity counts

At baseline, to children in both the control and experimental groups were similar in anthropometric measures, accelerometer wear and accumulated activity counts (Table 6.5). There were no changes between the groups after the intervention. Children who were randomized into the group that received lifestyle coaching prior to the 12-month measurements were similar in weight, height and BMI-for-Age percentile to children who did not receive coaching. Likewise, there were no differences in wear time and activity counts between children who received coaching prior to the 12-month visit and those who did not. Similarly, there were no significant increases or decreases in accelerometer wear from baseline to 12-months in either group (Table 6.5).

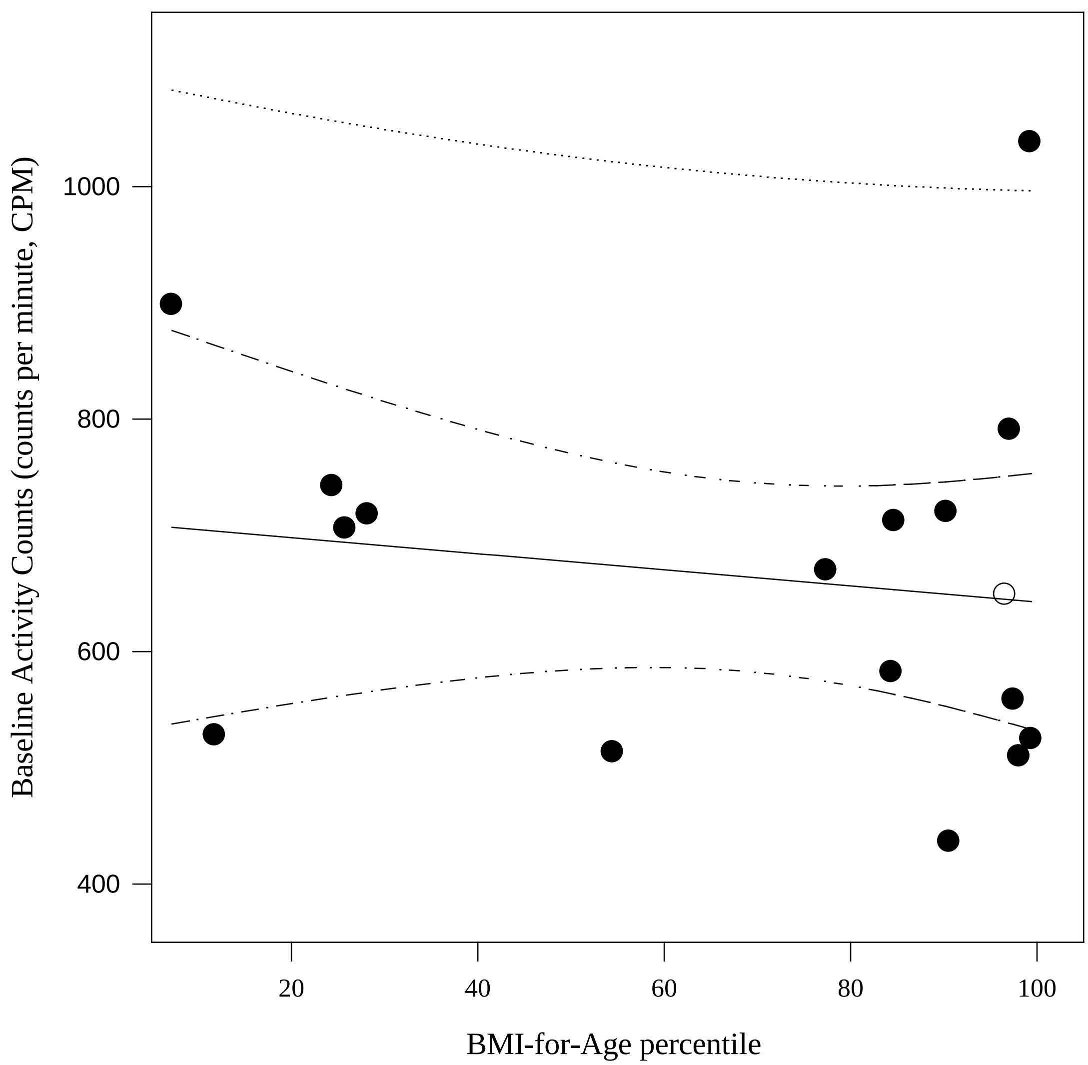
Table 6.5. Similarities between experimental group and control group children at baseline and 12-months

	Baseline Measurement (prior to coaching)			12-month Measurement (following coaching visits)		
	Control Group (no coaching)	Experimental group (received coaching)	*P*	Control Group (no coaching)	Experimental group (received coaching)	*P*
N	9	8		9	8	
Weight (kg)	37.2 ± 12.6	35.7 ± 10.6	*0.806*	41.6 ± 12.53	43.5 ± 15.9	*0.790*
Height (cm)	135 ± 0.07	133 ± 0.07	*0.497*	140 ± 0.08	141 ± 0.08	*0.707*
BMI (kg/m^2)	19.9 ± 4.8	19.8 ± 4.4	*0.997*	20.8 ± 4.6	21.3 ± 5.8	*0.860*
BMI-for-Age percentile	69.7 ± 33	67.5 + 39	*0.903*	69.2 ± 37	66.9 + 36	*0.923*
Days of wear	5.8 ± 0.7	5.8 ± 0.4	*0.744*	5.4 ± 0.7	5.4 ± 0.9	*0.744*
Minutes of wear/day	692 ± 118	589 ± 86	*0.057*	681 ± 59	740 ± 71	*0.082*
Activity counts (CPM)	711 ± 166	623 ± 140	*0.255*	576 ± 194	600 ± 227	*0.815*

BMI and activity counts

Although there were no significant changes in BMI-for-age percentiles, wear time and activity counts at the group level, there was a difference in the relationship between BMI and total activity counts at the baseline measurement and the 12-month measurement. At baseline, there was no relationship between BMI-for age percentile and activity counts (counts per minute) (Figure 6.2).

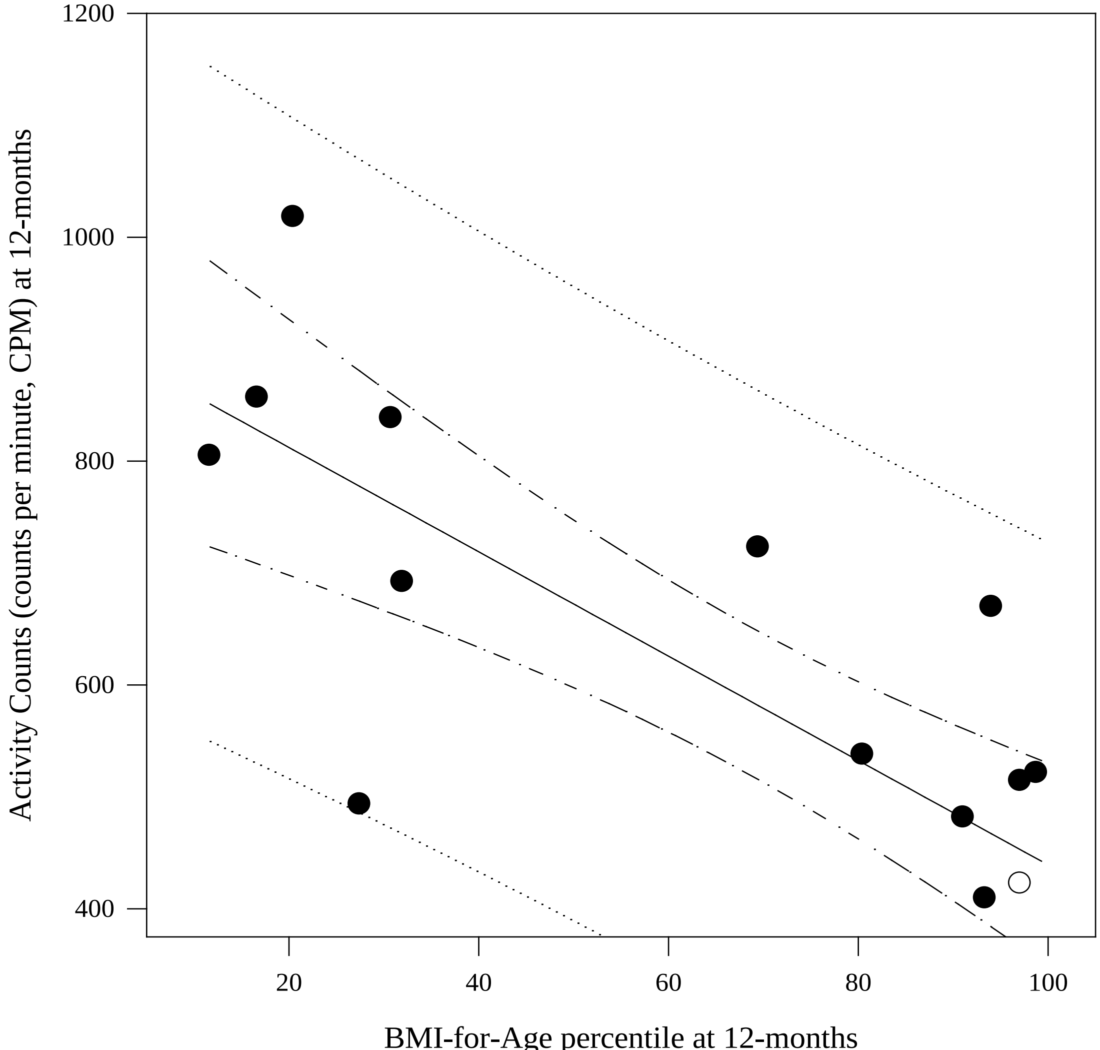
Figure 6.2. Relationship between activity counts (CPM) and BMI-for-Age percentile, at baseline



Children who fell into higher percentiles had similar activity count values to children who fell into lower percentiles. These results indicate that at the beginning of the study, there was no relationship between the amount of time kids were active during the day and their weight status.

However, when the relationship between BMI-for-Age percentile and activity counts was tested with data from 12-month measurement, there was a negative association (Figure 6.3). Children with higher BMI-for-Age percentiles had lower total activity counts than the children with lower BMI-for-Age percentiles. These suggest an association between increases in weight and the lower activity levels observed in the 12-month accelerometer data.

Figure 6.3. Relationship between activity counts (CPM) and BMI-for-Age percentile at 12-months.

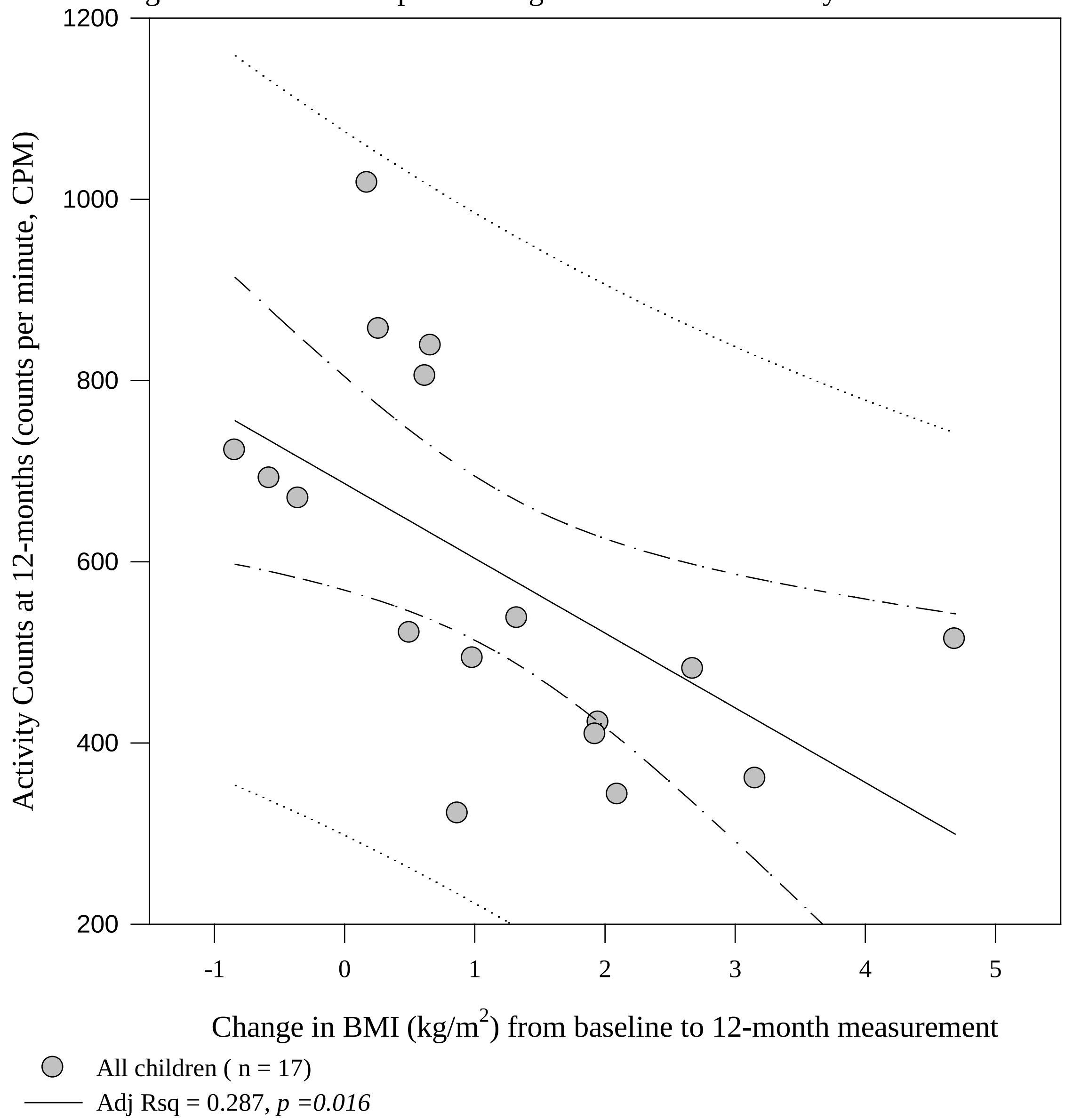


all children (n = 17)
Adj Rsq. = 0.612, *p<0.001*
power = 0.983

Changes in BMI, weight gain, and total daily activity counts

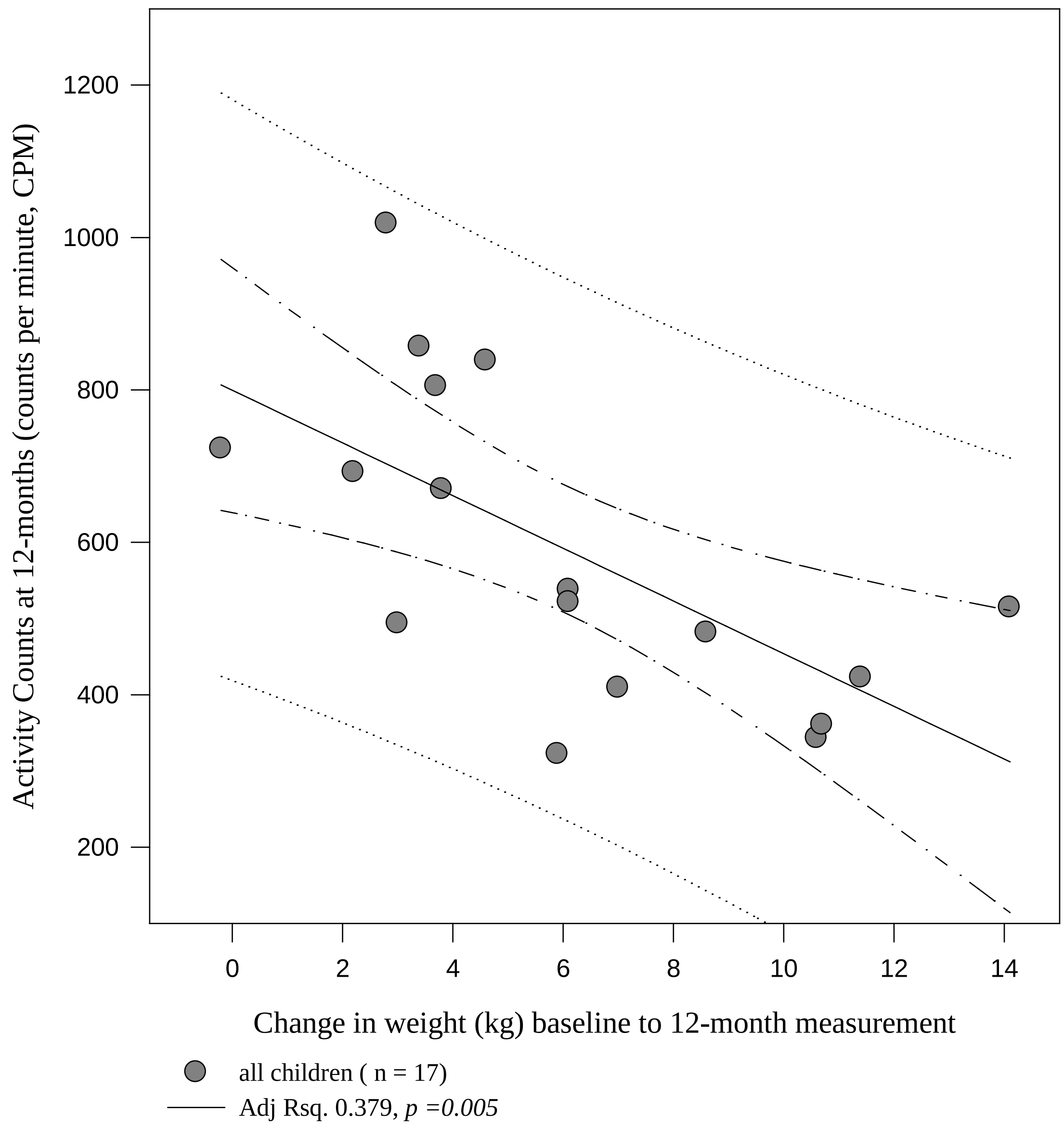
Because there was a significant relationship between BMI-for-Age percentile and activity counts at 12-months, gains in weight and BMI (kg/m^2) were compared to activity counts. Children with more gains (1.5 kg/m^2 or higher) in BMIs had lower total activity counts than children with less (1 kg/m^2 or less) gains in BMIs (Figure 6.4)

Figure 6.4. Relationship between gains in BMI and activity counts at 12-months



Similarly, children with higher weight gains over the 12-month period had lower total activity counts than children who had lower gains in weight (Figure 6.5).

Figure 6.5. Relationship between weight gain (kg) and activity counts at 12-months.



The data suggest greater gains in weight were associated with lower daily physical activity levels at the 12-month period. These results support the second hypothesis tested: H_2:

Children with who have greater increases in weight and BMI will have lower levels of physical activity at 12 months than children will lower increases in BMI.

Changes in Physical Activity Levels

Overall, there were no significant changes in the amount of time spent at different physical activity levels from the baseline to 12 month measurements (Table 6.5). All children spent the largest percentage of their day at sedentary and light activity levels at both baseline and 12-months (97% and 98% respectively). Likewise, the smallest percentage of the day (3% and 2%) was spent at moderate-vigorous activity levels (Table 6.5). In fact, there was a slight, but non-significant decrease in the number of minutes spent at moderate-vigorous activity levels from the baseline to the 12- month measurement. These data do not support the first hypothesis tested: H_1 which states: Children will have higher total counts and more minutes of moderate-vigorous activity at the 12-month measurement than at the baseline measurement.

Table 6.6. Changes in minutes at different activity levels, all children (N = 17).

	Baseline		12-Month		*Change*
Activity Levels	Mins/day	% of day	Mins./day	% of day	*p*
Sedentary	540 ± 84	76%	556 ± 83	78%	*0.493*
Light	151 ± 50	21%	140 ± 42	20%	*0.406*
Moderate-vigorous	22 ± 13	3%	17 ± 16	2%	*0.233*
Total	713 ± 80	100%	713 ± 71	100%	*0.999*

These results also indicate that children in this sample were not meeting the current recommendations for physical activity among children. According to the most current physical activity guidelines for Americans (US Department of Health and Human Services 2008), children should engage in at least 60 minutes of moderate to vigorous activity each day.

However, in this sample children averaged less than 30 minutes of moderate to vigorous activity each day.

Changes in weight and minutes spent at sedentary light and moderate activity levels.

Although there were no group changes in the amount of time spent at different activity levels, there was a positive correlation between weight gain and number of minutes spent in sedentary activity. Similarly, there was a trend towards a negative correlation between weight gain and minutes spent engaged in light activity levels, and a lower trend between weight gain and minutes engaged in moderate-vigorous activity.

Children who had the higher weight gain spent more time at sedentary activity levels at 12 the month measurement than children with lower weight gain (Figure 6.6). Likewise, children with higher weight gain tended to spend less time in light and moderate-vigorous activity than children with lower or no weight gain (Figure 6.7, Figure 6.8).

Figure 6.6. Relationship between weight gain and minutes spent at sedentary activity levels, all chilldren (N = 17)

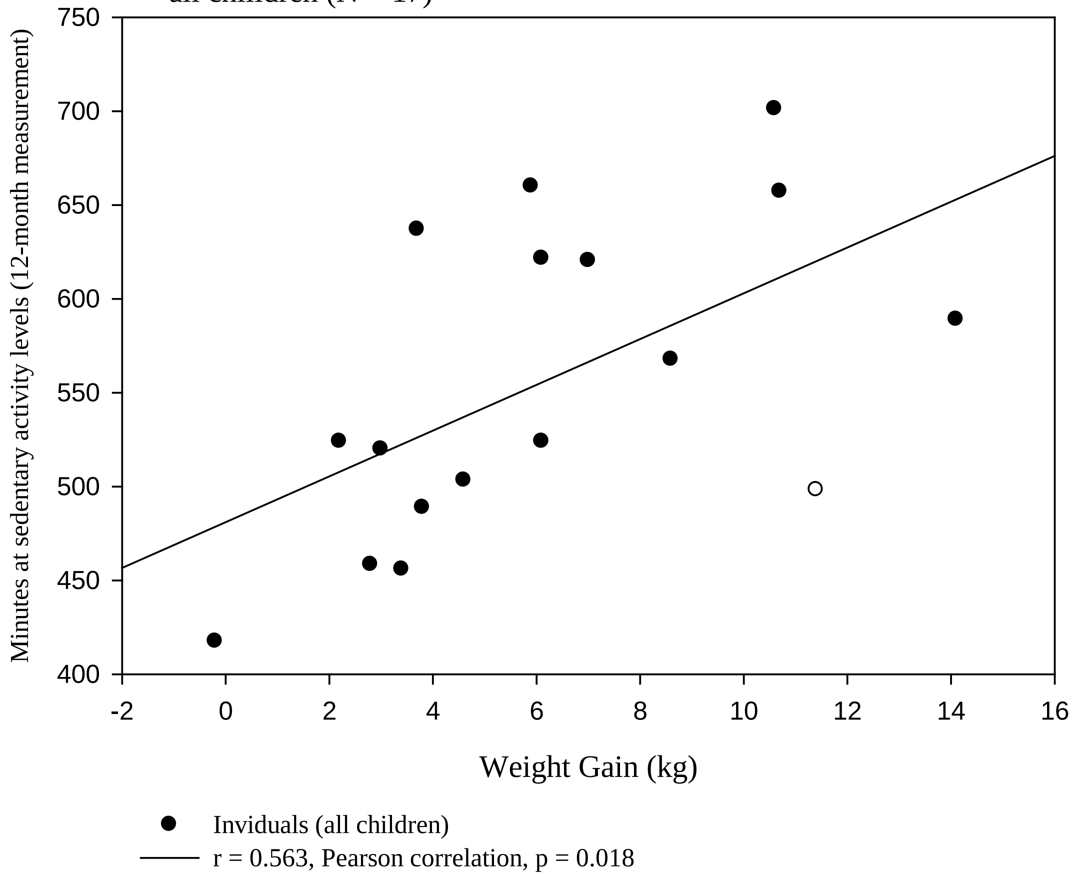


Figure 6.7. Relationshp between weight gain and minutes spent at light activity levels (N = 17)

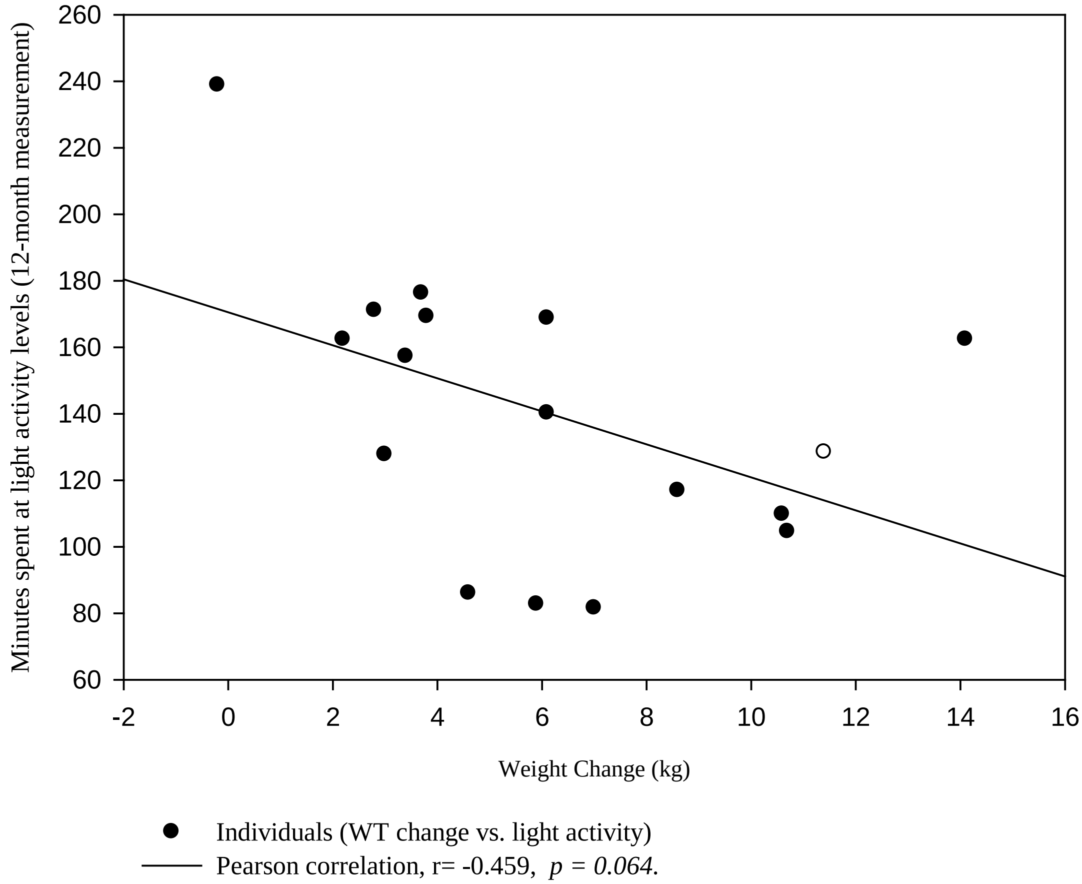
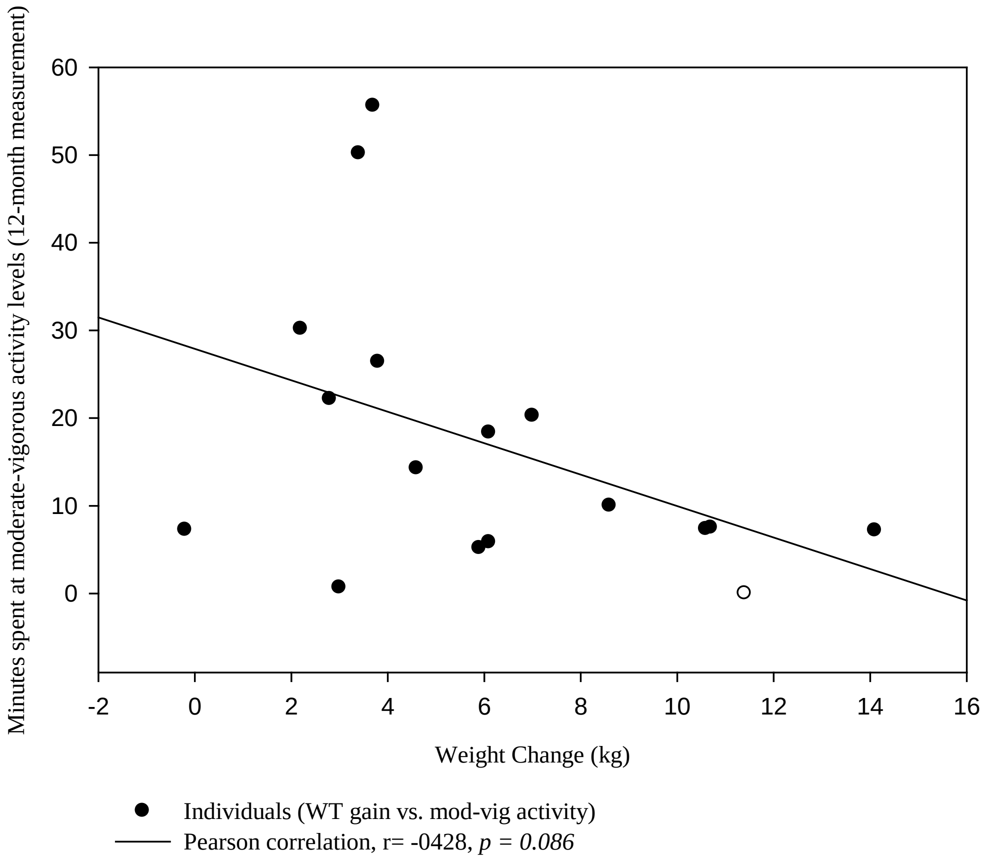


Figure 6.8. Relationship between weight gain and time spent at moderate-vigorous activity levels (N = 17)



Association between intervention status and time spent at different activity levels

There were no differences in amount of time spent at different activity levels between experimental and control group children at the 12-month measurement. Both groups of children wore the accelerometer for similar periods of time. Children who received lifestyle coaching prior to the 12-month clinic visit spent the largest percentage of their 12-month wear time at sedentary activity levels, and least amount of time at moderate-vigorous activity levels. These percentages were similar to those for children who received no coaching prior to the 12-month measurement. (Table 6.7)

Table 6.7. Time spent at different activity levels at 12-months, by intervention status.

Activity Levels	Experimental group Mins/day	Experimental group % of mins	Control Group Mins/day	Control Group % of mins	*P*
N	9		8		
Sedentary	569 ± 95	77%	539 ± 71	79%	*0.470*
Light	153 ± 47	21%	126 ± 31	19%	*0.194*
Moderate-vigorous	18 ± 16	2%	16 ± 16	2%	*0.759*
Total	740 ± 71	100%	681 ± 59	100%	*0.082*

DISCUSSION

In this study, children were of similar age, and there were no age related changes in physical activity levels. Likewise, there were no differences between boys and girls, suggesting no gender differences in weight changes or physical activity in this sample. However, the power for gender comparisons was below the desired power of 0.800 (power = 0.050). In a larger sample of children with more age variability from this population, there may be age and gender differences similar to those reported by other studies (Treuth et al. 2005; Trost et al. 2002; Troiano et al. 2008). Nevertheless, due to the lack of differences and small sample size; boys and girls were pooled in order to assess changes in weight and physical activity among the entire group, over the 12-month period. As a group, the children did not make significant changes in their activity levels during the 12-months that they participated in the San Luis Valley Healthy Family Project.

At both the baseline and 12-month measurements, all of the children spent the highest percentage of their day at sedentary activity levels, and the lowest percentage at moderate-vigorous activity levels, As such, the children did not meet the recommendations of 60 minutes or more of moderate-vigorous activity (US Department of Health and Human Services 2008). Furthermore, receiving lifestyle coaching prior to the 12-month measurement did not result in increased changes in activity levels from the baseline to 12-month measurement. Children who received coaching spent similar amounts of time at sedentary and moderate-vigorous activity levels to children who received no coaching.

However, there was an association between weight gain and activity levels. Individuals who gained more weight over the 12-month period spent more time in sedentary activities than the individuals who did not gain, or gained less weight over the same period. The higher weight gain individuals also showed trends towards less time at light and moderate-vigorous activity levels.

Interestingly, the relationship between weight changes and time spent at moderate-vigorous activity levels was weaker than the one between weight changes and light activity. These results suggest that light activity may play an important role in children's daily physical activity; and perhaps may be more of a mitigating factor in weight management than moderate-vigorous activity levels. Furthermore, Treuth et al. (2005) have argued for the importance of light activity in decreased body fat and BMI among rural girls. In their study, time spent in light activity was significantly correlated with lower percentage of body fat. Likewise, in this study, light activity may be a mitigating factor in maintaining normal weight status among children.

This study is limited by its small sample size in comparison to previous studies which have measured physical activity among children (Treuth et al. 2005; Butte et al. 2007; Troiano et al. 2008). Despite this limitation, this study was able to assess longitudinal changes in physical activity and their relationship to weight changes among children living in rural Colorado. In addition, the study was able to indirectly identify the relationship between participating in a 12-month study and changes in physical activity.

Among the children in this sample, there was no association between the experimental group (received coaching) and the control group. It is possible that a period of 12-months is not long enough to detect behavioral changes in physical activity levels. However, it is also possible that coaching had no effect on children because it was a home-based program, and the maximum number of visits was. Children spend most of their day at school, interacting with other children and teachers. Therefore, the amount time spent with the lifestyle coach in the household was much less than exposure to peers and teachers at school. As a result, it is possible that the coaching did not allow for enough time influence behavioral changes among children.

Despite its limitations, the results of this study may be useful in developing future studies directed at understanding the impact of weight maintenance or weight gain on children’s daily physical activity. As such, a promising direction would be to look at longitudinal changes in physical activity among a larger sample of children. In addition, it would be useful to examine a sample of children with more age variability in order to better understand age related changes in physical activity.

CONCLUSION

The results of the analysis do not support the first hypothesis tested, and suggest that there were no major changes in levels of physical activity over a 12-month period, despite the family’s participation in a 12-month study. Furthermore, the results indicate that activity levels for the children in this sample, regardless of intervention status, were low, and they did not meet recommendations for minutes of moderate-vigorous activity levels.

The results, however, do support the second hypothesis tested, and suggest that weight changes over time, eventually have a significant impact on daily physical activity. The data indicated no association between BMI-for-Age percentile or weight and physical activity at the baseline measurements, but showed a strong relationship between the amount of weight gain over a 12 month period and physical activity at the 12 month measurement. Furthermore, children with more gains in weight over the 12 month period, spent more time in sedentary activity levels than children with less weight gain, further supporting the hypothesis and indicating a relationship between weight change over time and long term physical activity levels. In this study, children who gained the most weight had the lowest number of activity counts and highest number of minutes spent at sedentary activity levels.

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CHAPTER VII:

ROLE OF PRIMARY CAREGIVERS ON CHILDREN'S PHYSICAL ACTIVITY: DO ACTIVE PARENTS HAVE ACTIVE KIDS?

INTRODUCTION

Despite the positive health benefits of moderate to vigorous physical activity, many children in the United States do not meet recommended levels of daily physical activity (Andersen et al. 1998; Gordon-Larsen et al. 2004; Pate et al. 2006). Over the past fifteen years, there has been interest in understanding the factors which contribute to low physical activity levels. Some have linked television viewing, limited access to play areas and safety concerns about playing outside to low physical activity levels among children (Jago et al. 2005; Jago et al. 2010; Davidson and Lawson 2006).

Others studies, in addition to looking at television viewing and access to play areas, have examined the influence of parental behaviors on their children's physical activity levels. Although many aspects of parental behaviors (e.g. physical activity, support, views) have been studied, their relationship to children's physical activity levels is still unclear. Previous studies have used a number of different methods to study the association between parent and child physical activity. These methods include: questionnaires, surveys, self-report data, observations and objective measures such as pedometers and accelerometers, and have produced mixed results (Hovell et al. 1996; Davison et al. 2003;; Sallis et al. 1998; Freedson and Evenson 1991; Jago et al. 2010). A few studies which used self-report data or questionnaires have found that support or encouragement, as well as parental time spent in vigorous activity were predictors of, or strongly correlated to children's physical activity levels (Sallis et al. 1988; Hovell et al. 1996; Davidson et al. 2003; Hovell et al. 1996 and Welk et al. 2003). For example, Sallis et al. (1988) found a correlation between parental time spent in vigorous physical activity and the time their young children spent in moderate physical activity. Davison et al. (2003) found that parental support from at least one parent can be a predictor of their child's physical activity levels. Hovell et al. (1996) also found that parent education and parent support were predictors of their children's physical activity levels. On the other hand, similar types of studies have also reported no correlation between parents and their children's physical activity levels. For Example, Sallis et al. (1993) found no correlation between parental support and children's physical activity among parents with young pre-school children. Similarly, Pate et al (1997) did not find an association between parent and child physical activity levels.

Like previous studies which have used subjective methods to assess parent and child physical activity patterns, studies using objective measures (i.e. pedometers and accelerometers) have also found mixed results. In a study of young children (ages 4-7 years), Moore et al. (1991) report a strong correlation between active parents and active children. In this study, children of active parents were more than twice as likely to be active as children with non-active parents. More recently, Jago et al (2010) found some associations between sedentary behaviors among parents and daughters, but no association between the amount of time parents spend engaged in physical activity and the time children spend engaged in physical activity.

The mixed results provided by all of these studies indicate that there are still questions about the association between parent and child physical activity. Even less understood is the influence of parental physical activity on their elementary school aged children living in rural communities within the United States. There have been studies which have examined physical activity among rural children. For example, Treuth et al. (2005) examined physical activity patterns among rural children living in the eastern United States. However, no studies have used accelerometers to measure physical activity among rural children and their parents at the same time. While some of the aforementioned studies have included elementary school children, the majority have focused on adolescents and very young children. For example, previous studies, like those of Moore et al. (1991) have used objective measures of physical activity to focus on physical activity patterns of parents and their preschool aged children. More recent work has addressed elementary school children, but has not been conducted in the United States. For example, the most recent study by Jago et al. (2010) which used accelerometers to assess physical activity levels of parents and children was conducted in the United Kingdom. It is likely that the household and school environment setting is different than many of the rural communities in the United States. Therefore, the purpose of this study is to utilize accelerometer data to examine the association between parent or adult caregiver physical activity levels and children's physical activity levels among elementary school aged children living in rural Colorado. This study also examined the relationship between household variables (parent marital status, household income and number of siblings participating in the same study) and children's physical activity levels. The following hypotheses were tested:

> H_1: Physical activity, as measured in counts per minute (CPM) of primary caregivers will be a predictor of physical activity (CPM) among their children.
>
> H_2: Primary caregivers who spend more time in moderate to vigorous activity (MVPA) levels will have children with lower BMI-for-Age percentiles than caregivers who spend less time in moderate to vigorous activity levels (MVPA).

METHODS

Participants

Participants in the study were a sample of 29 children (13 girls and 16 boys) between 7 and 11 years of age (at baseline) and the primary caregiver in the household from 23 families participating in the San Luis Valley Healthy Family Project.

As part of the Healthy Family Project, participants were scheduled for 2 clinic visits over a 12-month period (baseline and 12-month follow-up). During the visits, the primary caregiver answered questions about ethnicity and household income. As part of the visits, a series of anthropometric measures were collected (height, weight, waist circumference), and all family members who agreed to monitor their physical activity levels following the visits were fitted and sent home with an accelerometer to wear.

In addition to participating in the Healthy Family Project, children and their parents were invited to participate in a supplemental study in which the child and his or her family was observed throughout the day. During the observations, the researcher kept a physical activity diary for each child. The diary involved the researcher recording location, people present, body position, activity and activity level at 1-minute intervals. Five families agreed to participate in the ethnographic study.

Written informed consent was signed by all participating adults in the family, and assent forms were signed by all participating children. All research was approved by Colorado Multiple Institution Research Board.

The Primary Caregiver

The primary caregiver in this study was defined as the adult in the household who was primarily in charge of shopping for food and meal planning. The primary caregiver also provided all of the information about household demography, answered any additional questions about the children or adolescents within the family who were participating in the Healthy Family Project study, and provided parental consent for any children or adolescents in the household, who participated in the study. Among families in the Healthy Family Project, the primary caregiver could be either the mother or the father.

Household Characteristics

Households were categorized into 3 types based on information provided by the primary caregiver during clinic interviews for the Healthy Family Project. The categories were defined as follows: single parent, two parents, single parent living with another adult extended family member. In some cases, there was a second parent in the household, but this parent declined to participate in the study; however, the household structure was still considered to be a two parent household.

Participant Demography

Information about household size was collected from the primary care giver when they first talked to a researcher about participation in the study. Both ethnicity and household income information were collected from the primary caregiver and children during the clinic visits Children's ethnicity was based on self-reported data. During clinic interviews parents and their children were asked the following questions about ethnicity: 1) "Is *(name's)* Spanish or Hispanic orgin?" (yes or no, don't know, refused); 2) "If yes, which of the following best describes *(name's)* heritage" (Mexican, Mexican American, Chicano, Cuban, Puerto Rican, Guatemalan, Other Spanish/Hispanic) 3)"What is *(name's)* race?" (White, African American, Black, Asian, Pacific Islander, American Indian, Alaska Native, Other, Don't know, Refused)

Household income was also based on self-reported data provided by the primary caregiver in the study. Participants were asked to report their household income by income brackets of $10,000/ year and up (e.g. 0-$9,999/year) (Table 7.3).

Table 7.1. Income brackets and codes used in the Healthy Family Project.

Income Bracket
0 - $9,999/year
10, 000 – 19, 999/year
20, 000 – 39,999/year
40, 000 – 49,999/year
50, 000 – 59, 999/year
60, 000 – 69,999/year
70, 000- 79, 999
80, 000 and up

Poverty status was determined by comparing the date of the clinic visit, household size and reported household income to United States Federal Poverty thresholds for household size and income for the same year (United States Department of Health and Human Services 2005, 2006, 2007, 2008). For this study, participants were classified as being above or below the United States poverty threshold.

Anthropometry

Height and weight measurements were collected from the children during clinic visits for the Healthy Family Project. Height was measured to the nearest 0.10 cm using an Accustat stadiometer (Genentech Inc.). Weight was measured to the nearest 0.5 kilogram using a balance beam scale and waist circumference was measured to the nearest 0.10 cm with a measuring tape.

BMI was calculated as weight (kg) / height (m^2). Age and gender specific BMI-for-Age percentiles were calculated and summarized using the BMI calculator tool provided through the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention 2009). Weight status classification was also based on BMI-for-Age gender specific percentiles developed by the National Center for Health Statistics and Centers for Disease Control (2000). Based on age and gender specific BMI-for-Age percentiles, children were classified as underweight, normal weight, overweight and obese following the more recent Centers for Disease control expert committee recommendations (Barlow et al. 2007) (Table 4.1).

Table 7.2. BMI-for-Age percentile based weight status classification.

Percentile Range	Weight Status
Below 5^{th} percentile	Underweight
5^{th} – 84^{th} percentile	Normal weight
85^{th} – 94^{th} percentile	Overweight
95^{th} percentile or above	Obese

Measurement of Physical Activity

Physical activity for both adults and children was measured using an Actigraph 7164 (Actigraph, Ft. Walton Beach, Fl) accelerometer. The Actigraph 7164 accelerometer is a uniaxial activity monitor that detects limb movements within a 0.5-7-Hz frequency range, and filters out high frequency vibrations such as riding in a car or a lawn mower. Body movements are recorded as counts in 1 minute cycles (i.e. epochs) (MTI Health Services, FT. Walton Beach FL).

All participants in the household were asked to wear the monitor at the same time, during waking hours for 7 consecutive days following their scheduled clinic visit. If an individual skipped a day during the 7-day wear period, he or she was instructed to wear the accelerometer for an additional day immediately after the 7-day period. In addition to wearing the accelerometer, all participants were to record the time that they put the accelerometer on in the morning, and the time that they took it off in the evening. Participants were also asked to record any time that they removed the accelerometer for 15 minutes or more, and record any extra days that they wore the accelerometer.

Data Cleaning and Reduction

After being worn, accelerometers were downloaded and saved on a study computer using Actisoft software (version 3.1.1). For children in the sample, the files were then analyzed for valid days and minutes using the Actisoft software (version 3.1.1) and MAHUffe software (www.mrc-epid.cam.ac.uk). For the adults in the sample, the accelerometer files were cleaned separately by Mary Dinger (University of Oklahoma) using the NCI processing program in SAS (version 10) (see Appendix 7.1 for details). Once the data were cleaned and reduced, the accelerometer files were analyzed for accumulated physical activity (counts per minute) and time spent at different physical activity levels (see below).

Only accelerometer data which met inclusion criteria were used in the analysis. In order to meet the criteria, an accelerometer data file had to show that the participant wore the accelerometer for a minimum number of days, and hours each day of wear. Because the children and adults in the study had slightly different wear patterns, the criteria for including an accelerometer file in the study were slightly different. For children, a file was considered valid, if the child wore the accelerometer for at least 4 days and 8 hours each day (see chapter 5 for detailed description). For the adults, files were considered valid if the individual wore the accelerometer for at least 4 days and 10 hours each day. For both adults and children, the criteria used for NHANES accelerometer data were used to determine periods of non-wear. Periods with 60 minutes or more of continuous zeros were considered time where the accelerometer was not being worn or malfunctioning and were excluded from the analysis.

Summary Measures of Physical Activity

Valid accelerometer files for both children and adults were summarized using overall physical activity over the wear period and time spent at different activity levels (e.g. sedentary or light and moderate-vigorous). Mean counts per minute were used as in indication of the overall physical activity among both children and adults. Mean minutes of moderate to vigorous activity and the amount of time the accelerometer was worn were used to determine the percentage of day spent at moderate-vigorous activity levels (MVPA).

For children, the different activity levels were categorized using count per minute (CPM) cut off values developed by Puyau et al. (2002) (Table 7.3). These cutoff points have been validated for children between the ages of 7 and 13 years using direct calorimetery, have been used in other studies with both rural and urban children of similar age (Treuth et al. 2005; McClure et al. 2009 and Jago et al. 2010) and are most strongly correlated with direct observations of physical activity patterns among a subsample of children in this study (see chapter 5 for a detailed description of the rationale).

Table 7.3 Activity levels and cutoff points for children, following Puyau et al. (2002)

Counts per minute (CPM)	Activity Level
<800	Sedentary
800 -3199	Light
≥3200	Moderate to vigorous (MVPA)

For adults included in the analysis, activity levels were defined using cutoff values developed for adults by Freedson et al. (1989) Table 7.4. These cutoff values have been previously used for adults and are the criteria used for the US National Health and Examination Survey (NHANES) (Mathews et al. 2005).

Table 7.4. Activity levels and cutoff points for adults after by Freedson et al. (1998)

Counts per minute (CPM)	Activity Level
$\leq$499	Sedentary
500 -1951	Light
$\geq$1952	Moderate to vigorous (MVPA)

Data Analysis

All statistical analyses were conducted using Sigma Plot (Version 11.2, Sys Stat Software Inc). Descriptive statistics for anthropometric measures, household characteristics, household income, as well as both children's and adult's overall physical activity levels and time spent at moderate-vigorous physical activity levels were described as means ± standard deviations. A correlation analysis was used to determine the association between primary caregiver and child's activity levels, children's BMI-for-age percentile and adult overall activity levels (as CPM). A t-test was used to compare differences in primary caregiver physical activity levels between parents with normal weight children and overweight/obese children. A multiple linear regression model was used to determine predictors of children's overall physical activity levels and time spent at moderate-vigorous activity levels. Included in the models were: household characteristics (single parent; two parents, single parent with extended family); household income, number of siblings of similar age, number of older siblings primary caregiver physical activity, and BMI-for-Age percentile. An alpha level of 0.05 was used for all tests.

RESULTS

Sample

A total of 29 children (16 boys and 13 girls) and their primary caregivers had valid accelerometer data and were included in the sample. The boys and girls in the sample were similar in age and body weight (Table 7.5) and therefore pooled for the accelerometer analysis.

Table 7.5. Comparison of age and weight of children included in the analysis.

	Boys (n = 16)	Girls (n = 13)	*p*
Age (years)	10.1 ± 1.0	10.6 ± 1.2	0.186
Height (cm)	140.9 ± 8.5	143.2 ± 12.2	0.566
Weight (kg)	41.4 ± 12.9	43.7 ± 16.8	0.687
BMI (kg/m2)	20.6 ± 5.0	20.7 ± 6.1	0.949
BMI-for-Age percentile	66.6 ± 35	63.1 ± 34	0.788

When boys and girls were pooled into one group and then classified into weight status groups, slightly less than half could be classified as overweight or obese. Because there were only four overweight children, overweight and obese children were pooled into one group for further analysis (Table 7.5).

Table 7.6 Weight status classification of children inlcuded in sample.

Weight Status		All children
Normal Weight	N %	17 58.6%
Overweight/Obese	N %	12 41.4%
Total Percent of total	N %	29 100%

Household characteristics

The majority of the sample included households with two parents. However, five families were single parent household, and five were single parents living with an extended family member. Six of the households had two children participating in the Healthy Family Project. Household size, when including children and parents who declined to participate in the study, ranged between two (parent and child) and six individuals. Single parent households had the youngest primary caregivers and lowest household income in the sample. The ages of children participating in the study were similar across groups. Participating children from single parent households tended to have the lower median BMI-for-Age percentiles than children from two parent households (Table 7.7)

Table 7.7. Comparison of age, household size, income and children's ages by household characteristics.

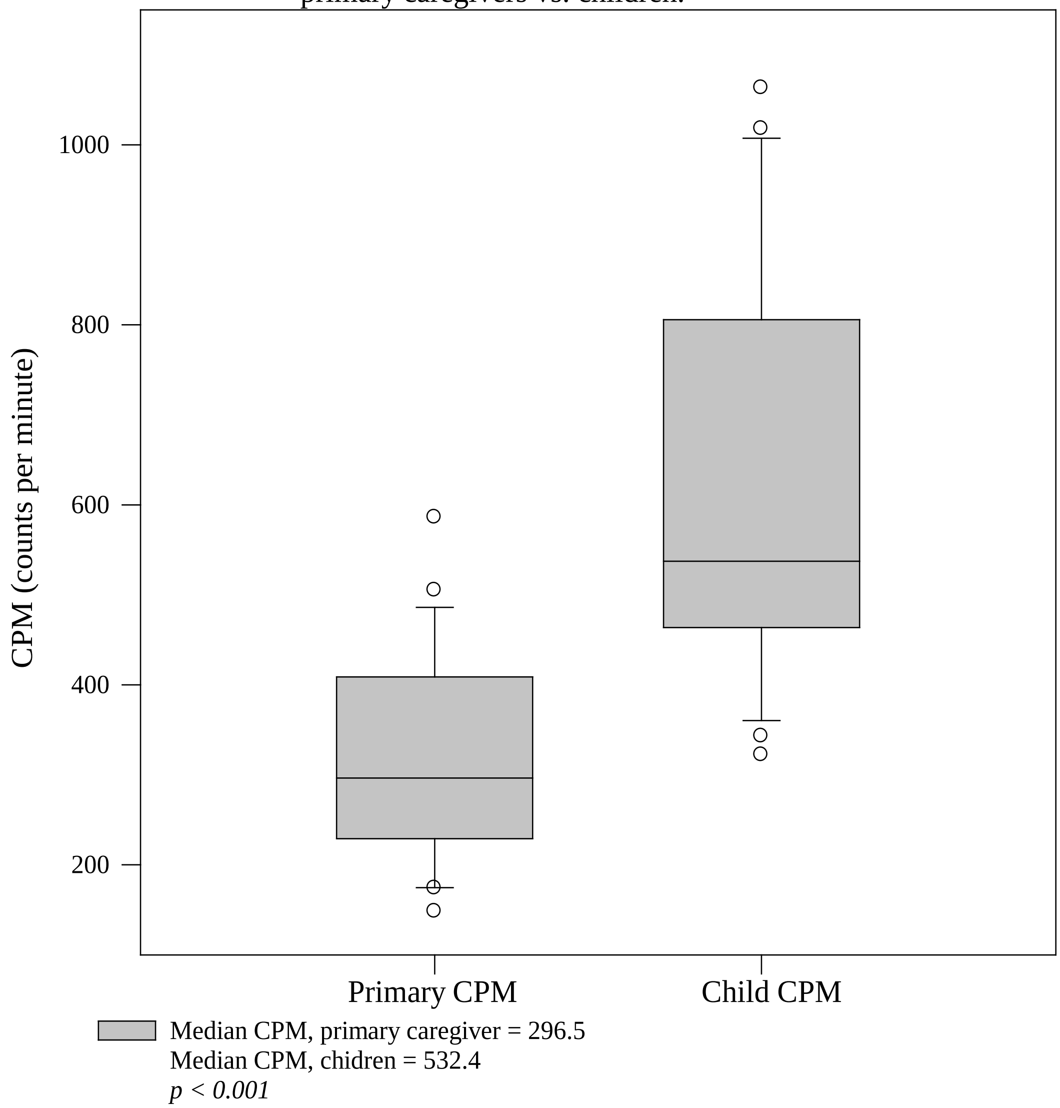
	Two parent	Single parent	Single parent Living w/extended family	*p*
N	19	5	5	
Age * (primary caregiver)	41.4 ± 9.5	34.5 ± 4.7	51.5 ± 10.2	*0.019*
Household size (includes non-participants)	4.7 ± 1.1	3.6 ± 0.5	3.4 ±1.1	*0.020*
Household income	47,893 ± 22, 004	26,999 ± 21,389	55,999 ± 16,733	*0.090*
Age (participating children)	10.3 ± 1.2	10.5 ± 1.0	10.3 ± 1.4	*0.939*
BMI-for-Age percentiles* (participating children)	92.6	30.8	57.0	*0.140*

*Percentiles are reported as median values here, sample was not normally distributed

Physical activity (counts per minute, CPM)

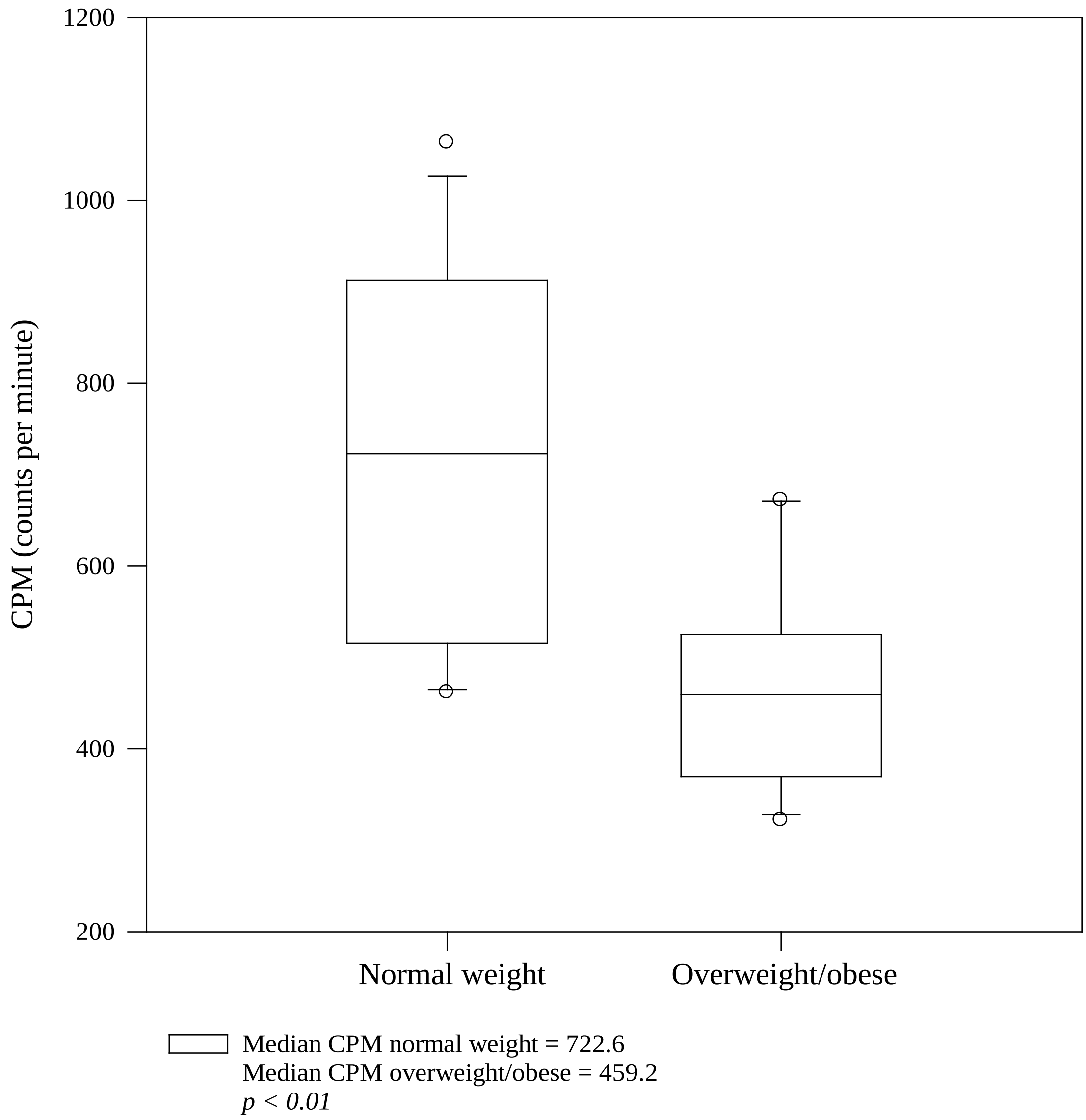
When children's physical activity was compared to primary caregiver's physical activity, children accumulated higher counts per minute (CPM) than their primary caregivers, indicating higher physical activity among the children (Figure 7.1).

Figure 7. 1. Physical activity as measured by counts per minute (CPM), primary caregivers vs. children.



When primary caregivers were excluded from the sample, and children’s physical activity was compared by weight status, normal weight children had significantly had higher physical activity their overweight/obese counterparts (Figure 7.2).

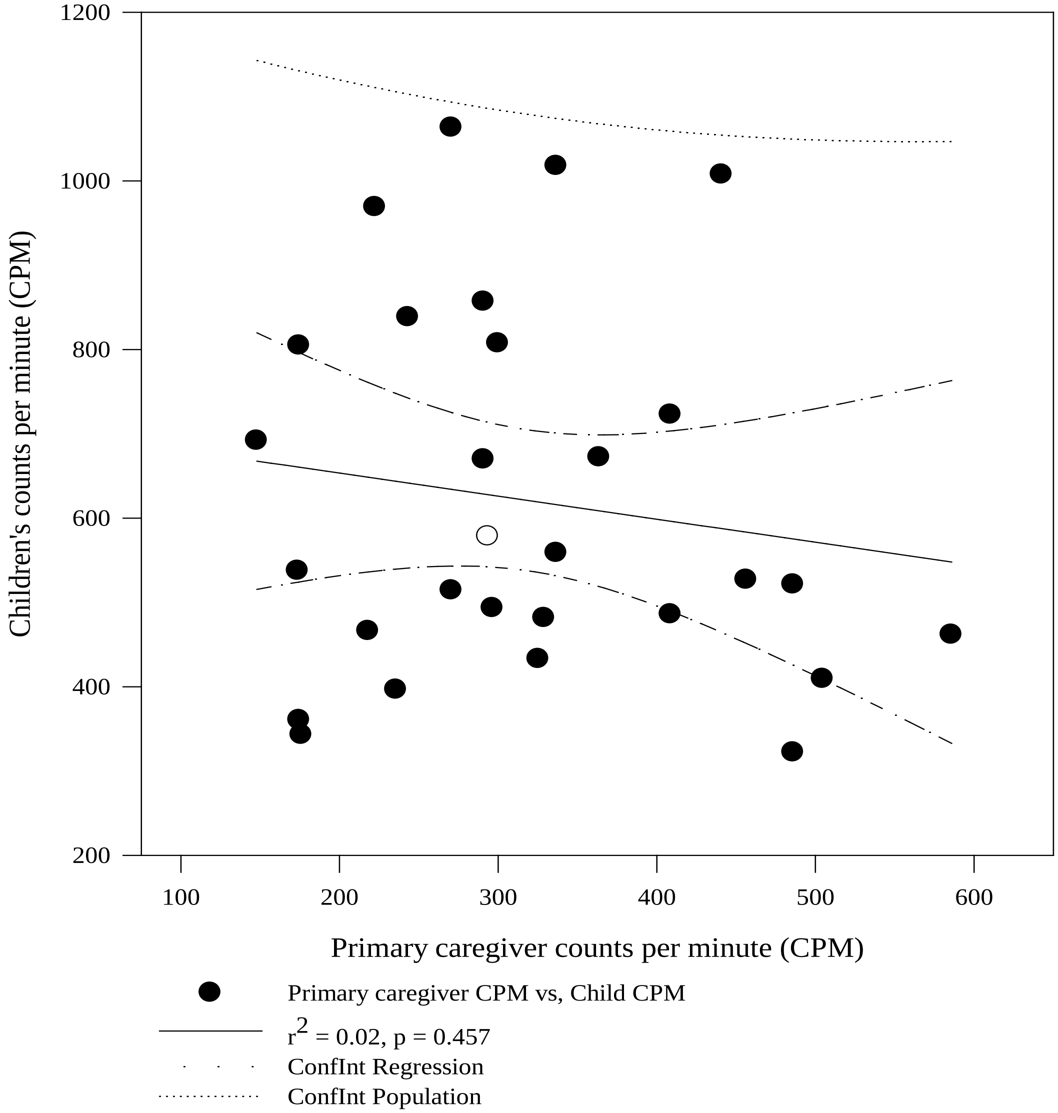
Figure 7.2. Physical activity by weight status, children only



Association between primary caregiver's activity and their children's physical activity.

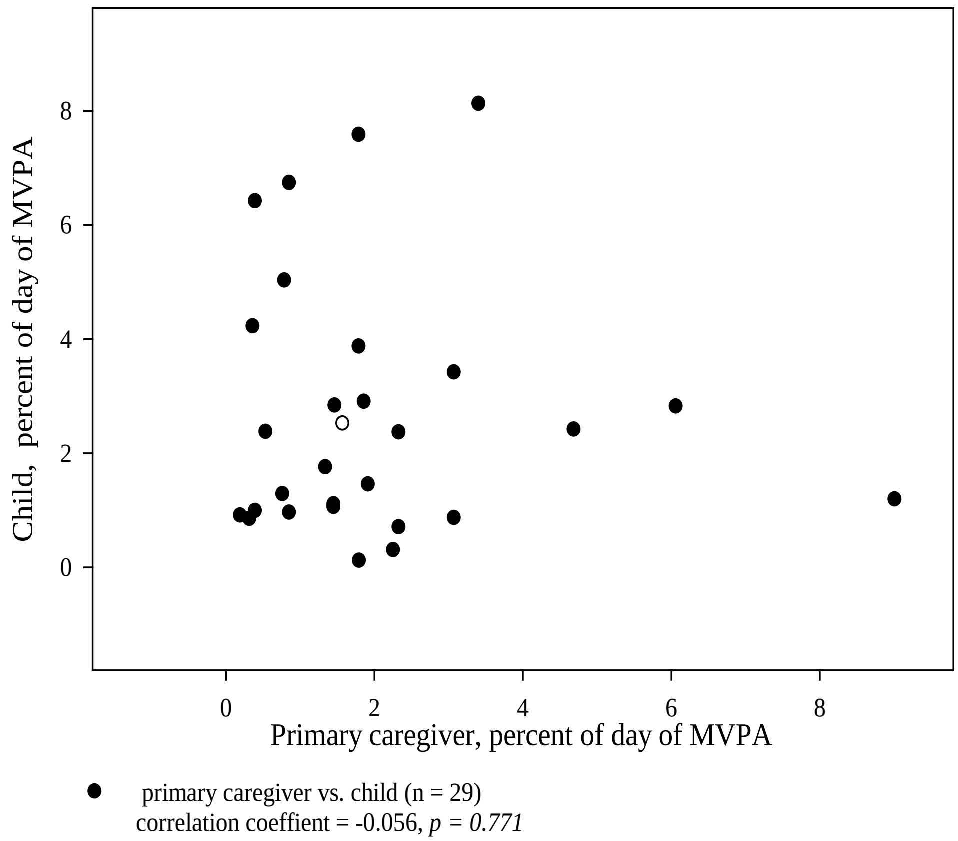
Primary caregivers with higher activity counts did not necessarily have children with higher activity counts. When placed into a linear regression model, primary caregiver physical activity did not predict their children's physical activity. These results do not support the first hypothesis tested: H_1: Overall physical activity, as measured in counts per minute (CPM) of primary caregivers will be a predictor of overall physical activity levels (CPM) of their children (Figure 7.3).

Figure 7.3. Relationship between primary caregiver and child physical activity (CPM), (all children and primary caregivers, n = 29).



Similarly, there was no correlation between the amount of time the primary caregiver spent at moderate-vigorous activity levels and the amount of time their children engaged in moderate to vigorous physical activity levels (Figure 7.4).

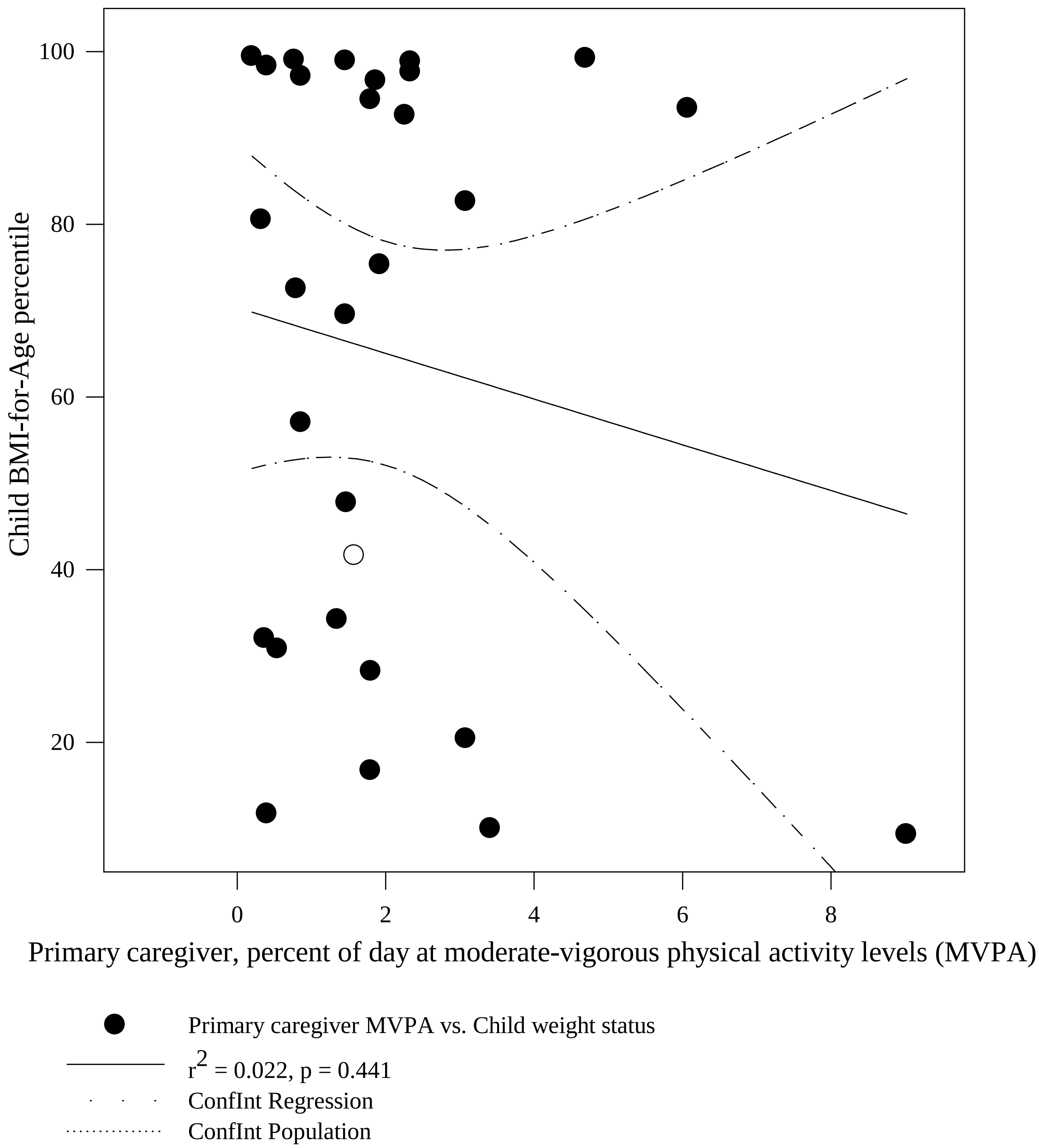
Figure 7.4. Relationship between primary caregiver and child moderate-vigorous physical activity (MVPA).



Influence of primary caregiver's activity levels on their children's weight status

There was no association between primary caregiver physical activity levels and children's weight status. Nor was there an association between the amount of time the primary caregiver spent in moderate-vigorous physical activity (MVPA) and the BMI-for-Age percentiles of their children (Figure 7.5)

Figure 7.5. Influence of primary caregiver MVPA on children's weight status.



In general, the majority of primary caregivers had low levels of moderate-vigorous activity (MVPA), and those who had accumulated the most MVPA, had children with similar BMI-for-Age percentiles as those who accumulated very low levels of MVPA. These results do not support the second hypothesis tested:

H_2: Primary caregivers who spend more time in moderate to vigorous activity (MVPA) levels will have children with lower BMI-for-Age percentiles than caregivers who spend less time in moderate to vigorous activity levels (MVPA). (Figure 7.5).

Finally, there were no differences in overall physical activity and the amount of time spent in moderate to vigorous activity levels between primary caregivers of normal weight children and those of overweight/obese children (Figure 7.6, 7.7)

Figure 7.6. Association between child's weight status on primary caregiver physical activity .

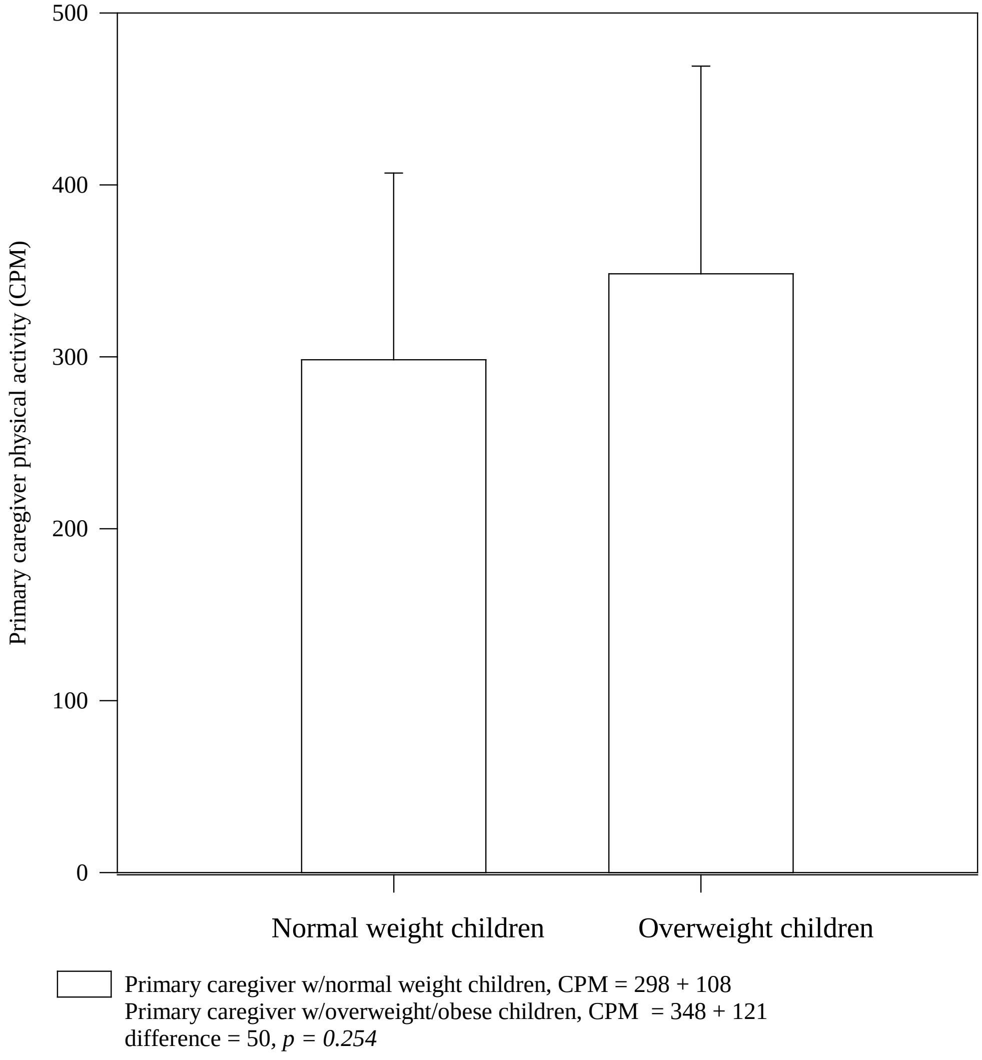
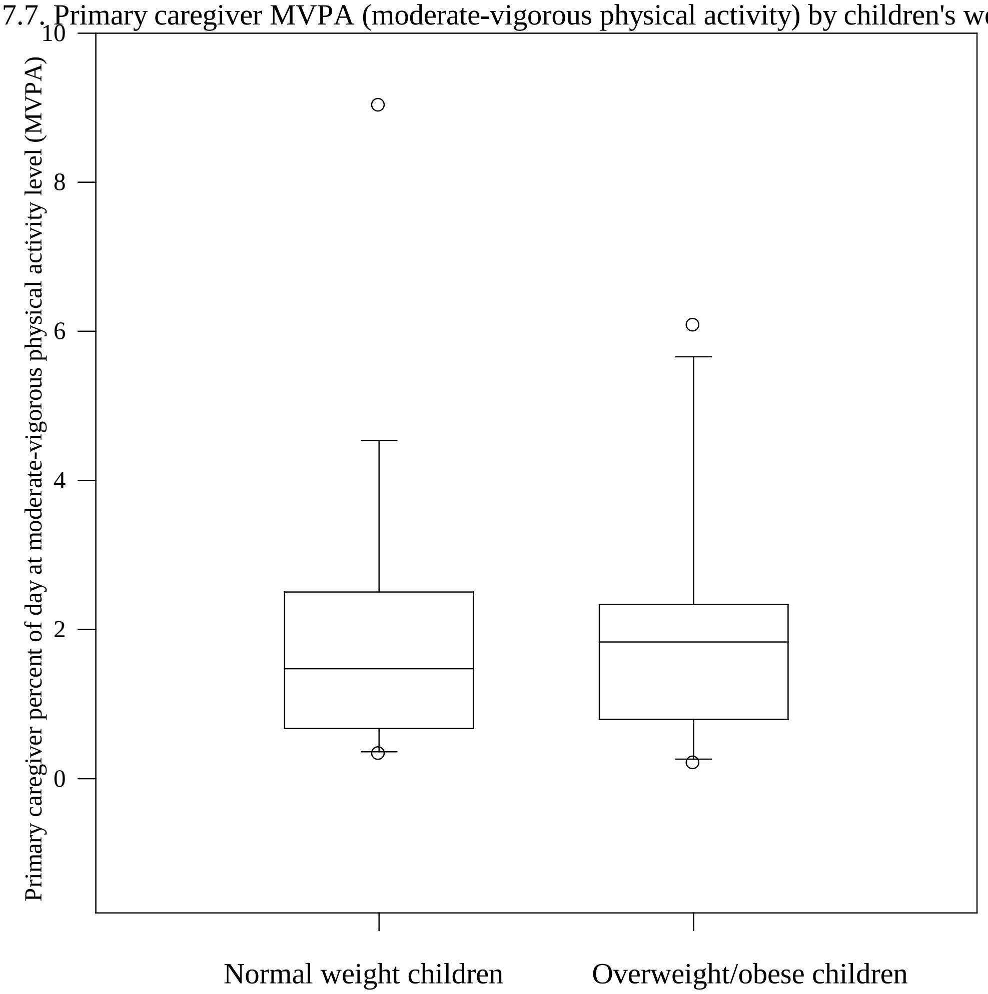


Figure 7.7. Primary caregiver MVPA (moderate-vigorous physical activity) by children's weight status



Other predictors of children's volume of physical activity and MVPA

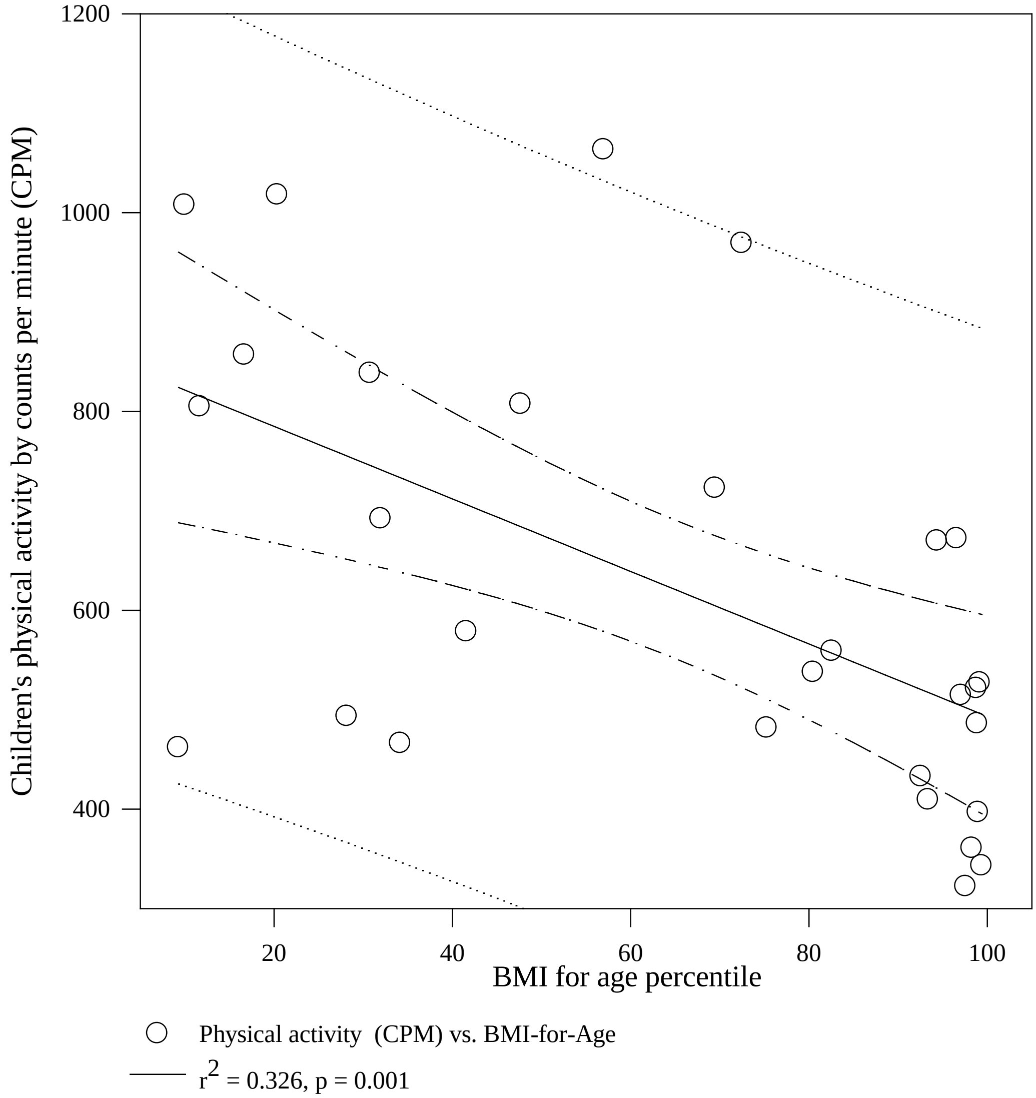
Household characteristics, primary caregiver physical activity patterns and having siblings in the study were not predictors of children's overall physical activity levels. However, BMI-for-Age percentile was a predictor of a child's overall physical activity patterns (Table 7.7).

Table 7.8. Predictors of children's physical activity (CPM).

Predictor variable	*p*
Household structure	*0.107*
Household size	*0.621*
Household income	*0.499*
Age of primary caregiver	*0.457*
Primary caregiver physical activity (CPM)	*0.711*
Siblings of similar age	*0.836*
Older siblings	*0.561*
Child's BMI-for-Age percentile	***0.003***

The pattern within this part of the model was as follows: children who fell into higher BMI-for-Age percentiles also accumulated lower counts per minute (CPM) than children who fell into lower BMI-for-Age percentiles (Figure 7.8).

Figure 7.8. Child physical activity (CPM) vs. BMI-for-Age percentile.



Similarly, neither household characteristics nor primary caregiver physical activity patterns were predictors of the amount of time children spent engaged in moderate-vigorous physical activity (MVPA) (Table 7.9). However, BMI-for-Age percentile and having a sibling (older or of the same age) both predicted the amount of time a child engaged in MVPA (Table 7.9).

Table 7.9. Predictors of children’s accumulation of moderate-vigorous physical activity (MVPA)

Predictor variable	*p*
Household structure	*0.087*
Household size	*0.621*
Household income	*0.184*
Age of primary caregiver	*0.542*
Primary caregiver physical activity (CPM)	*0.655*
Sibling of same age	***0.022***
Older siblings	**< *0.001***
Child’s BMI-for-Age percentile	**< *0.001***

DISCUSSION

In this sample, there was no association between primary caregiver’s overall physical activity (in counts per minute, CPM) or intensity (moderate-vigorous physical activity, MVPA) of physical activity and their children’s intensity of physical activity. In this study, primary caregivers with high levels of physical activity did not necessarily have children with high levels of physical activity. Likewise, primary caregivers who spent a higher percentage of their day engaged in moderate-vigorous activity (MVPA) did not always have children with high percentages of MVPA. These results are similar to recent results reported by Jago et al. (2010). In their study, the authors used accelerometers to measure physical activity of parents and their 10-11 year old children in the United Kingdom, and found no association between parent and child physical activity. Jago et al. (2010) argue that their findings may represent a time in childhood where children are beginning to assert some independence from their parents, and therefore, a direct association in physical activity may not be as clear among older children as the association between parents and their younger children. While this may partially be the case among the children in this study, observations and informal interviews with families did not support the idea children were attempting to assert independence by being more active than their parents. Moreover, the measures used in this study were likely not sensitive enough to pick up such behaviors. Therefore, the results here do not, or cannot support Jago et al.'s (2010) argument. However, there are likely other factors contributing to the lack of association between parent and child physical activity. One contributing factor could be parent occupation. Many of the primary caregivers reported that their occupations required relatively low levels of physical activity (e.g. sitting at a desk, standing, slow walking) (Table 7.10).

Table 7.10. Common types of occupations reported by primary caregivers.

Occupation	Sitting/Standing/Walking
Health Care (nursing, home health care)	Standing, walking
Office (accounting, billing, bookkeeper, etc)	Sitting
Teacher	Sitting/standing
Cafeteria Worker (school or hospital)	Standing/walking
Child Care (home/day care)	Standing/sitting
Homemaker	Sitting/standing/walking
Warehouse Manager	Standing/walking
Disabled	Sitting

Similarly, primary caregivers who reported "homemaker" as their occupation had relatively low physical activity levels. For example, among the subsample of children in this study who were observed, the primary caregivers were either "stay at home moms" or worked at night and stayed at home with the children during the day. During the observations of the children, it was noted that the primary caregivers spent the day engaged in light household activities, watching television, light childcare, and sitting and talking with extended relatives, but were not highly active. At the same time, their children were observed engaging in free play in the yard. For example, two of the children observed, spent a large part of the morning playing “tag” in their yard. In another case, the child being observed played on a trampoline and swingset in her yard. During observations, another went for a bike ride around the neighborhood while her father was watching television and her mother was running errands. Finally, one child was observed while he helped his uncle remove concrete from a porch. In this case, the child was picking up large pieces of broken concrete, putting it in a wheelbarrow, and rolling the wheelbarrow to his uncle’s truck and dumping the rock. At the same time, his mother was inside visiting with the aunt.

For the children who were not directly observed, there could be similar differences in parent and child activities, especially if a parent has a job where he or she is relatively sedentary throughout the day. Likewise, for children who were not observed, but wore the accelerometer at school, there could also be discrepancies between parent and child physical activity levels. During the school year, children spend most of their day in school, and typically have at least one recess a day and a PE class during the week. All of the children who participated in this study attended schools which have at least two recesses a day and PE classes at least once a week.

Although the primary caregivers in this study had relatively low physical activity levels, it is possible that they still facilitated physical activity among their children by encouraging their children to be active, enrolling their children in group sports or other activities at the local recreation center or Boys and Girls Club, volunteering at their children’s sports activities or transporting their children to sporting events or recreational activities. All of these types of facilitating behaviors were present among some of the primary caregivers in this study. For example, the mother of two children who were observed continuously encouraged her girls to play outside in the yard. The mother was concerned about the girls walking to the nearby park by themselves, so, she had set a time each day to walk with her girls to the nearby park so that they could play in the playground. During an informal interview with another primary caregiver in the study, the parent talked about how she had just enrolled her daughter in a summer gymnastics program at the recreation center. During the summer, the primary caregiver of another family worked nights and spent the day with his daughters while his wife was at work. This parent volunteered as the softball coach for his daughters' local softball team. In addition to attending the scheduled team practices, this parent would also encourage the girls to practice during the day by taking them to the park. The two older daughters in this family also played soccer. Both parents spent time volunteering to help with fundraising, taking players to practice, and volunteering to travel with the team when they played outside of the Valley. These observations support previous findings which have suggested that parental support can positively influence children's physical activity behaviors. For example, Heitzler et al. (2006) found that among 9-13 year olds in the United States parental support, either through transporting children to events, attending events, or volunteering to help with events or teams were key factors in not only shaping children's physical activity levels, but also in how children viewed physical activity. Similarly, Brustard (1993) also reported that among fourth graders (mean age 10.4 years) physical activity enjoyment was related to parental encouragement. Children with parents who regularly encouraged physical activity expressed higher levels of enjoyment with physical activity, and were more likely to engage in daily physical activity.

Based on the results of the accelerometer analysis and observations of families within this study, it seems that parental physical activity itself is not associated with children's physical activity behaviors. However, based on some observations and informal interviews with parents, it is likely that parental support is a contributing factor to children's physical activity levels.

Interestingly, while primary caregiver physical activity was not associated with children's physical activity levels, weight status and having a sibling were. Among children in this study, those with higher BMI-for-Age percentiles had lower overall physical activity levels and the least amount of moderate-vigorous physical activity. These results are not surprising since low physical activity has been previously linked with obesity among other children in the United States (Andersen et al 1998; Butte et al. 2006; Butte et al. 2007). However, what is interesting is that children were more likely to have higher physical activity levels and accumulate more moderate-vigorous activity if they had at least one sibling. This is similar to results reported by Raudsepp and Viira (2000), who conducted 7-day physical activity recalls among adolescents (13-14 years) and their families living in Tartu, Estonia. In this study, there was a positive correlation between having a sibling and physical activity levels. Among children in the present study, the sibling or siblings may encourage physical activity through free-play either throughout the day during summer break or afterschool during the school year. This type of behavior was observed in at least one of the families in this study. In this family, the two older daughters spent most of their day engaged in free play in their yard; often running and playing tag. It is likely, that these girls would have been less active if they did not have another child to chase around the yard.

In addition to just having another person to play with, it is possible that an older sibling who participates in organized sports (e.g. soccer, football, basketball) may encourage their younger sibling to participate in the sport, or encourage physical activity through modeling. Some of the older siblings within families in this study were involved in organized sports. For example, one child had an older sister who played on the high school basketball team. In an informal interview during a clinic visit, this child talked about his sister, but also mentioned how much he liked basketball. In another family, the two older daughters played soccer, and encouraged the younger sister to practice some of the soccer tricks that they had learned.

In summary, the results presented here did not support the two hypotheses tested, and suggest that parental physical activity levels are not major correlates of children's physical activity behaviors among children in the San Luis Valley. However, the results reported here indicate that parental encouragement may play an important role in children's physical activity levels. The results also suggest that siblings are an important factor in physical activity among rural school children in Colorado. However, the demographic and accelerometer data presented here does not provide details about how having a sibling influences physical activity levels. Although, observations suggest that a sibling encourages more active free play at home, and older siblings may encourage physical activity through modeling, the results came from a relatively small sample of families. There are still many details about these relationships that have not been well studied, and future studies could benefit from focusing on a larger sample of children and their siblings.

CONCLUSION

Primary caregiver physical activity levels are not associated with their children's physical activity levels or weight status. However, parental encouragement and siblings may play a more important role in determining physical activity levels among children in this sample. The results of this study did indicate however, that being overweight and having siblings are associated with the amount of moderate-vigorous physical activity (MVPA) children engage in throughout the day. BMI-for-Age percentile was a strong predictor of activity levels. Children with high BMI-for-Age percentiles had lower physical activity levels than children with lower BMI-for-Age percentiles. Although all children in this study were relatively sedentary, children with at least one sibling spent a larger percentage of their day engaged in moderate-vigorous activity (MVPA) than those without siblings. In addition, BMI-for-Age percentile was a strong predictor of activity levels. Children with high BMI-for-Age percentiles had lower physical activity levels than children with lower BMI-for-Age percentiles.

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CHAPTER VIII:

DISCUSSION and CONCLUSIONS

Again, why do research in the San Luis Valley?

Although Colorado has one of the lowest obesity rates in the Country (Centers for Disease Control and Prevention 2009), adults and children living in the rural San Luis Valley, Colorado are disproportionately affected by obesity and obesity related chronic disease. Likewise, recent studies indicate that rural adults and children are at risk for obesity and obesity related disease (McMurray et al. 1999; Jackson et al. 2005; Patterson et al. 2004). The San Luis Valley is comprised of a number of small rural communities in south central Colorado, where previous research has indicated high rates of obesity and type II diabetes among families. Currently, research in the Valley has been designed to help at risk families make healthy lifestyle changes and decrease their risk for obesity, as well as prevent or delay the onset of type II diabetes. The San Luis Valley Healthy Family Project was a 12-month, randomized control trial, designed to test the effectiveness of home based lifestyle coaching on weight status, diet and physical activity patterns among families at risk for type II diabetes. Because the study invited all household members (adults, children and extended family) to participate, it provided an opportunity to examine dietary and physical activity patterns among elementary school children within the context of their household and community environment, as well as compare parental physical activity patterns with their children's patterns. Furthermore, another study, the School Environment Project, allowed researchers to visit the elementary schools which many Healthy Family Project children attended; this also provided the opportunity to examine the role of school in children's eating and physical activity behaviors. The purpose of this project was to bring all of these environments together in order to better understand how the household, school and community impact dietary and physical activity patterns among these children. The hypotheses tested in each section were developed within the context of the following research question:

> Q1: How do local social, cultural and environmental factors impact diet, physical activity and weight status among children in the San Luis Valley, Colorado?

Common variables considered in all analyses

Because energy balance was not directly measured in this study, body weight, weight status, and changes in weight status were used as indicators of long term energy balance among the children. When age and gender specific BMI percentiles were used to classify children into weight status categories, the prevalence of overweight and obese children was higher than the prevalence previously reported in NHANES 2003-2006 for children of similar age (Ogden et al. 2008). Likewise, the percentage of overweight and obese children in this sample was higher than the percentage reported in state-wide surveys of children between 1 and 14 years of age in Colorado. Almost half (47.5%) of the children could be classified as overweight or obese. Between 2005-2006, the Child Health Survey indicated that the percentage of overweight/obese children in rural Colorado was 33%. In 2007, urban and rural areas were combined for the survey, and the percentage of overweight/obese children in Colorado was 25.8% (Colorado Department of Public Health and Environment 2008). Interestingly, there were no gender differences in weight status among the children in this study, and the proportion of overweight and obese children in the sample did not change from the baseline measurements to the 12-month measurements.

Because the San Luis Valley has some of the lowest incomes in the state of Colorado, household income in addition to weight status, was considered in some of the analyses. Household income was based on self reported data provided by the primary caregiver in each household. Among families in this sample, the median household income was higher than the median income for the San Luis Valley, and the largest proportion of the sample fell above the Federal Poverty Thresholds (San Luis Valley Prevention Coalition 2007; United States Department of Health and Human Services 2005, 2006, 2007, 2008). Although there were families in the sample with very low incomes, the majority fell above the United States Federal Poverty Thresholds for household size. Among families in this sample, household income was not associated with children's weight status, dietary intake or physical activity levels.

In addition to weight status and household income, other variables considered in the analyses included: school district (Alamosa, La Jara, Monte Vista etc.), time of year (school year vs. summer) and household characteristics (single parent vs. two parents, number of siblings etc.). The association between these variables and dietary patterns, physical activity and weight status was mixed. School district was not associated with diet, but tended to be associated with physical activity levels. There were no seasonal changes in activity levels. While children's height and weight increased, as expected for normal growth, the proportion of normal weight and overweight/obese children in the sample did not change significantly. Furthermore, being in school or at home had no impact on diet or physical activity. Similarly, household characteristics were not associated with diet, but the presence of siblings was associated with physical activity levels

Finally, in order to provide context for some of the results presented here, observational data collected while living in the Valley, during visits to elementary schools, time spent with families who agreed to participate in a supplemental observational study, and informal interviews with adults and children during the clinic visits were also included in all of the analyses. These observations provided some context and suggested potential explanations for some of the results. For example, observations and interviews provided some insight into the high water intakes that were both reported in the dietary recalls and observed during the supplemental study. Details on the observations and their relationship to the results are discussed more in detail below.

Dietary Intake, diet quality and dietary patterns

The influence of energy intake and dietary habits on weight status was considered in the third and fourth chapters. Within these two chapters dietary intake, changes in dietary intake, diet quality, dietary patterns (sweetened beverage consumption and restaurant use), were all examined. The following hypotheses were tested in chapters 3 and 4:

H_1: For all children, there will be no change in reported energy intake or diet quality from the baseline to 12-month measurement.

H_2: Children with higher BMI-for-Age percentiles will have higher energy intakes and higher Healthy Eating Index-2005 (HEI-2005) scores than children with lower BMI-for-Age percentiles children at both baseline and 12-months.

H_3: For all children, there will be a positive correlation between total reported energy intake and HEI-2005 scores at both baseline and 12-months.

H_4: Children who consume a higher number of foods at school will have a higher quality diet than children who consume a fewer number of foods from school.

H_5: At both baseline and 12-months, sweetened beverages will be the most frequent type of beverage reported, and milk will be the least frequent.

H_6: Children with a higher percentage of eating occasions at restaurants will have higher BMI-for-Age percentile than children with a lower percentage of eating occasions at restaurants.

There were no changes in reported energy intake, dietary quality or dietary patterns among the children in this sample, and the results supported the first hypothesis tested; suggesting either that the children and their families did not make changes in their dietary habits between the beginning and the end of the study, or that 12-months is not a long enough period to observe dietary changes among elementary school age children.

Similarly there were no associations between reported energy intake, diet quality (HEI-2005 scores) and weight status, and children's reported energy intakes were significantly lower than their age, weight and gender specific estimated energy requirements (EER). These results did not support the second hypotheses tested, and differed from results reported in the 2004-2005 Dietary Assessment Study, in which a random sample of 732 children in the United States reported energy intakes higher than their Estimated Energy Requirements (EERs) (Clark et al. 2009). As such, the results suggest that the reported intakes among this sample were lower than those reported for children of similar ages in the United States, Canada and Crete within the past 10 years (Berkey 2000; Galloway 2007; Angelopoulous et al. 2009).

The lower energy intakes among children in this sample may reflect parental or familial beliefs about overeating and snacking; this was supported by some ethnographic data. On the other hand, the low reported energy intakes may also reflect reporting bias among the children. Previous studies have found that both overweight adults and children are less accurate in the intake reporting (Briefel et al. 2007; Domel Baxter et al. 2006). Because almost half of the children in this sample were classified as overweight or obese, it is possible that there was some weight status related reporting bias. This was further supported by the relationship between kilogram of body weight and weight status. Although there was no association between absolute energy intake and weight status among the children, overweight and obese girls had significantly lower energy intakes per kilogram of body weight than normal weight girls.

Another contributing factor could have been that all of the children were participants in the Healthy Family Project. Although only 25 of the children were randomized into an experimental group which received home based lifestyle coaching, all of the children participated in the clinic visits, dietary intake interviews and weight measurements. Thus, all of the children understood that the study was focused on weight management, healthy eating and physical activity. It is possible that just knowing they were part of a study interested in healthy eating and physical activity influenced their reporting on the day of the dietary recall. It is also possible that parents and children adjusted their eating patterns and energy intake just before the scheduled clinic visits. Therefore, it is likely that low reported energy intakes observed in this sample reflected a combination of these factors.

When diet quality was assessed using the Healthy Eating Index-2005 (HEI 2005) scoring system, there was no association between HEI-2005 scores and reported energy intake. Likewise, there was no association between HEI-2005 scores and BMI-for-Age percentiles, or HEI-2005 scores and number of foods consumed at school. These results did not support the third and fourth hypotheses tested, and are different than results reported in previous studies which examined diet quality among children (Fingwe et al. 2009; Briefel et al. 2009; Feskanich 2004; Angelopoulos 2009). There was no association between diet quality and energy intake, or diet quality and weight status, but results indicate that all of the children in this sample have relatively low quality diets; all of the children's HEI-2005 scores fell into the "poor" and "needs improvement" categories. Furthermore, intervention status (received coaching or did not receive coaching) had no impact on scores. Finally, HEI-2005 scores were lower than HEI-2005 scores reported for other children of similar age in the United States and Crete (Fingwe et al. 2009; Briefel et al. 2009; Feskanich 2004; Angelopoulos 2009).

Previously reported data suggest a positive association between the number of meals consumed at school and HEI-2005 scores. In two studies, children who reported higher energy intakes and eating more foods at school, had higher HEI-2005 scores than those who reported lower energy intakes and fewer meals at school (Briefel et al. 2009; Clark et al. 2009). However, among children in this sample, there was no association between the amount of foods consumed at school and HEI-2005 scores. Interestingly, however, children had lower overall HEI-2005 scores, but their scores for the individual component which represented added sugar and fat intakes (SoFAAS) were better than scores for NHANES children. These results suggested that children were consuming fewer added sugars and solid fats than children in other parts of the United States.

The overall low HEI-2005 scores among the children in this sample may simply reflect the low reported energy intakes, but it may also reflect local food patterns. Many of the patterns seen in the data were similar to those observed among adults and children who were not participating in the Healthy Family Project. Likewise, the higher scores for the added sugar and solid fat intake component scores suggest low added sugar and fat intakes, and may reflect some of the local food culture and school policies regarding snacking, sweets and fats. Observations and interview data from the schools as well as more general observations at community events, grocery stores and restaurants suggested that there were local food patterns which reduced snacking between meals and encouraged low sugar intakes. For example, many of the community events that were held in the Valley always offered free bottled water to the participants. Similarly, there were a number of community events that were heavily advertised and promoted “healthy eating”. For example, the Mobile Kitchen (MOKI) recipe demo and the Integrated Nutrition Program Parents Night at the Alamosa Recreation Center were events that promoted the consumption of low fat, fresh fruits and vegetables. Schools in the Valley had implemented “healthy snacks” policies and during this study, had removed vending machines. As a result, children were encouraged to drink water during community events, eat fruits and vegetables, and did not have access to sugary drinks, candies, or high fat snacks during the school day. This may partially explain the better added sugar and solid fat scores among children in the sample.

Although the patterns observed in the data were similar to the general patterns observed throughout the Valley, it is also possible that added sugar and solid fat intakes were lower than those among other children in the Valley because they were reported by children from families who had entered an intervention study with an interest in healthy eating, weight management and diabetes prevention. In short, the low energy intakes and low HEI-2005 scores were likely the product of several factors including parental views on snacking, school policies on snacks, as well as participation in the Healthy Family Project. One way that this could be tested in the future is to collect dietary data from a larger sample of children who are not participating in an intervention study.

Because of the potential link between obesity and increased sweetened beverage consumption and restaurant use (French et al. 2004; Nielsen et al. 2004 Bowman et al. 2004 and Nielsen et al. 2002), and the high proportion of overweight and obese kids in the sample, the impact of sweetened beverage consumption and restaurant use on dietary patterns and weight status was examined. Among children in this sample, the most commonly reported beverage consumed was water, followed by milk and then sweetened beverages. In terms of their contribution to energy intake, sweetened beverages contributed to less than 10% of the children's total energy intake. These results were different than beverage consumption patterns previously reported for children of similar age in the United States (French et al. 2004; Nielsen et al. 2004; Blum et al. 2005; Lytle et al. 2000; Wang et al. 2008) and did not support the fifth dietary hypothesis tested: Sweetened beverages will be the most commonly consumed beverage. Observations of children at home and at school, as well as interviews with parents and teachers further supported high water intakes reported in the recalls. Children were frequently observed drinking water, and adults talked about the dry climate of the Valley and the importance of drinking water. Another potential explanation for the high frequency of water consumption in this sample may be related to access. There were no vending machines in the elementary schools, so children only had access to water or milk throughout the school day. Additionally, some of the children in this sample lived in the smaller towns within the Valley, where corner stores, convenience stores and grocery stores were less accessible. However, water was easily accessible at school and at home. The accessibility and encouragement from adults may have been a major contributor to the higher than expected water intakes, and may reflect one aspect of living in a rural semi-arid mountain Valley.

Previous studies have also indicated a positive association between the number of meals consumed at restaurants and energy intake (Gonzales et al. 2002; Bowman et al. 2004), and frequent restaurant use and high energy intakes have been linked to obesity in the United States (Holguin et al. 2003; Nielsen et al. 2004; Ludwig et al. 2001; Chou et al. 2008). Among children in this sample, restaurant use was not common, but was consistent with low levels of fast-food use reported in state-wide surveys for children and adolescents in Colorado (Colorado Department of Health and Human Services 2006, 2007). However, restaurant use among children in this study was less frequent than restaurant use reported by 5th graders in other parts of the United States (Gonzales et al. 2002). Furthermore, there was no association between restaurant use and weight status among the children in this sample, and the results did not support the last diet hypothesis tested: Children with a higher percentage of eating occasions at restaurants will have higher BMI-for-Age percentile than children with a lower percentage of eating occasions at restaurants.

The beverage and restaurant use patterns observed in this sample are different than recent patterns reported for other children in the United States (Nielsen et al. 2002; Bowman et al. 2004), but are similar to patterns reported for children in the late 1970's (United States Department of Agriculture 1983). This difference may reflect the rural, relatively isolated nature of the San Luis Valley. For example, the largest concentration of restaurants in the Valley was in the largest town, Alamosa. Thus, the concentration was lower in some of the smaller towns. In some towns, there were only one or two restaurants with limited operating hours, whereas in other towns, there were none. For families living in these smaller towns, access to a restaurant may be a 15 to 30 minute drive. For some families, it is easier to eat at home rather than pile into the car and drive to a restaurant. For a few families, restaurant access may be further limited by not having access to a car. This was observed in the supplemental study, where one family relied on a relative for access to a car. It was further supported through interviews with school staff. During one interview, a school principal talked about a family living in Center (a small town 20 miles north of Alamosa) that did not own a car, and had to rely on neighbors or extended families to get to Alamosa to buy groceries. For this particular family, and most likely for other families in similar situations, restaurant use was inconvenient and likely not a common practice.

On a final note, the beverage and food consumption patterns observed in this sample suggest that diet may not be directly linked to the high obesity among some children, particularly those living in the Valley. These results are inconsistent with popular media, as well as some research have linked sweetened beverage consumption and fast-food/restaurant use to excessive energy intake and the obesity epidemic (Holguin et al. 2003; Nielsen et al. 2004; Ludwig et al. 2001; Chou et al. 2008). However, the data presented here suggest that the children in this sample have beverage and restaurant use patterns similar to those reported for children prior to the obesity epidemic in the 1970's (Bowman et al. 2004; Nielsen et al. 2002; Guthrie et al. 2002; United States Department of Agriculture 1980). Yet, despite these patterns, almost half of the children in the study were overweight and obese, much like other parts of the United States. Likewise, obesity among children in the Valley is still a concern among school administrators, public health nurses and other researchers working in the Valley.

Physical activity

In addition to diet, this study examined physical activity. The 5th, 6th and 7th chapters examined the association between physical activity levels and weight status among the children in the sample. The results presented in these chapters suggested that physical activity levels may have had a stronger impact than diet on weight status among the children studied. Accelerometer data and observations were used to examine levels of physical activity, relationship between physical activity and weight status, changes in physical activity patterns, and the association between household characteristics and physical activity. Chapters 5, 6, and 7, tested the following hypotheses:

> H_1: Children with lower BMI-for-age percentiles will accumulate higher accelerometer counts per day.
>
> H_2: BMI-for-age percentiles will be negatively associated with time spent in moderate to vigorous activity

> H_3: Children will have higher activity counts and more minutes of moderate-vigorous activity at the 12 month measurement than at the Baseline measurement.
>
> H_4: Children with who have greater increases in BMI will have lower levels of physical activity at 12 months than children will lower increases in BMI.
>
> H_5: Overall physical activity levels, as measured in counts per minute (CPM) of primary caregivers will be a predictor of overall physical activity levels (CPM) of their children.
>
> H_6: Primary caregivers who spend more time in moderate to vigorous activity (MVPA) levels will have children with lower BMI-for-Age percentiles than caregivers who spend less time in moderate to vigorous activity levels (MVPA).

Because accelerometers measure accelerations in movement every minute over the course of several days, and higher count accumulation is related to high levels of activity, they can be used as in indicator of the amount of time spent at different physical activity levels. In this study, families were instructed to wear the accelerometer during all waking hours for 7 consecutive days following their baseline and 12-month clinic visits.

There were no age or gender differences in physical activity levels among the children. These results were different than previous studies which have reported higher activity levels among boys than girls of similar ages (Treuth et al. 2005; Trost et al. 2002; Troiano et al. 2008). Likewise, there were no seasonal differences in activity patterns among children in this sample. These results are also different from recent studies which have observed seasonal differences in accelerometer data, and report children being more active in summer than winter (Rowlands et al 2009; Rowlands et al. 2006; Rifas-Shipman et al. 2001).

While there were no age, gender or seasonal differences in activity levels, there was an association between weight status and activity levels. Among children in this sample, BMI-for-Age percentiles and weight status were negatively associated with total activity counts, average counts per minute and time spent in moderate-vigorous activity levels, and supported the first two physical activity hypotheses tested. Normal weight children accumulated more total activity counts and had higher average counts per minute (CPM) than overweight or obese children, indicating that the normal weight children were engaging in more activity at higher activity levels than either overweight or obese children. Although these results supported the hypotheses tested, they did not agree with a previous study by Treuth et al. (2005) who found no differences in activity levels between normal weight and overweight rural school children. However, they were similar to results by Butte et al. (2007) who found that normal weight children accumulated significantly more activity counts than their overweight counterparts. In addition, Butte et al. (2006) and Strong et al. (2005) found that overweight children self-report lower activity levels than normal weight children. Previously reported results, and the results presented in this study suggest an important role of physical activity in weight status among elementary school children.

Although the results indicate that normal weight children spent more time in moderate-vigorous activity levels, they also indicate that all of the children had low activity levels and spent the largest percentage of their day engaged at sedentary and light activity levels. The results also indicate that the children were not meeting US recommendations for physical activity (60 minutes or more of moderate-vigorous activity on most days), and are similar to Butte et al. (2007) and Treuth et al. (2005) who reported that children spent the largest percentage of the day in sedentary or light activity levels. Given the large percentage of time spent at sedentary and light activity levels among all children in this and previous studies, it is important to note the potential role of light physical activity in children's energy balance. Although, normal weight children in this sample accumulated more moderate-vigorous activity than overweight children, their activity levels were low relative to recommendations for children (Centers for Disease Control and Prevention). However, their total activity counts and counts per minute were higher than overweight children, indicating more time spent at light activity levels than overweight children. Overweight children spent significantly more time at sedentary and less time at light activity levels than normal weight children. These results suggest that light activity, while not commonly considered in the literature, may also be and important factor for maintaining a healthy weight among children. Furthermore, Treuth et al. (2005) have also argued for the importance of light activity in decreased body fat and BMI-for-Age percentiles among rural girls. In their study, light activity, not moderate-vigorous was correlated with a lower percentage of body fat among girls.

The results of the accelerometer data were supported by observations of a subsample (n = 5) of Healthy Family Project children, observations during visits to elementary schools, and informal observations of children at parks and community events. Among the Healthy Family Project children who were observed, 86% of the observed day was spent in sedentary or light activities (milling around, sitting in the grass, standing around in unstructured play). In between the long blocks of sedentary or light activities, there would be several very short, but intense bursts of running or jumping. These patterns were similar to those observed among children at recess. During recess, there would be longer periods of children standing on playground equipment, followed by a short burst of running. A similar pattern was also observed in some of the school PE classes. During class, there were periods of instruction, where children would be sitting or standing, followed by short periods of activity. A number of PE classes observed, included “tag” games during the class period. For example a popular tag game that was observed among two of the supplemental study children, and in 3 different PE classes, at 3 different schools was “freeze tag”. During this game, everyone runs from the “tagger”, and once someone is tagged, he or she must stop in the place he or she was tagged, and remain still until the end of the game. In both the schools and home-based observations, these tag games would last for 10-15 minutes before a new game or activity was initiated. On the days that these games were observed in PE classes, the activity patterns during the game were very similar to the count patterns observed the accelerometer data collected from Healthy Family Project Children. Likewise, the children who were observed as part of the supplemental study also demonstrated a similar pattern. These observed patterns suggest that children change their activity levels very quickly, and the 1-minute recording epochs set in the accelerometer may not have picked up some of their moderate-vigorous activities. Because of this, some of the time spent in moderate-vigorous activity may not have been recorded. However, children wore the accelerometers for several days. Therefore, the accumulation of counts over several days provided a general pattern in activity levels, and this pattern indicated that normal weight children were more active than overweight and obese children in the sample. Finally, the observations indicated that children accumulate bouts of moderate and vigorous activity differently than adults. Rather than planned, long, sustained bouts of moderate-vigorous activity levels (e.g. working out at the gym), children have unstructured, short bouts of moderate-vigorous activity.

Because the children were part of a 12-month study, they were asked to wear accelerometers for a baseline measurement and again a year later for a 12-month measurement. Although not all of the children in the sample agreed to wear the accelerometer during both periods, there was a subsample that did, and this provided an opportunity to look at physical activity patterns longitudinally. Repeated measures indicated that there were no differences in activity counts, counts per minute (CPM) or time spent in different activity levels between the baseline and 12-month measurement and at both measurements, and children spent the largest percentage of their day in sedentary and light physical activity levels. These results did not support the third physical activity hypothesis tested. However, as found in Chapter 5, weight status was strongly correlated with physical activity. Among the children with longitudinal accelerometer data, individuals who gained more weight over the 12-month period (those heavier at 12-months than baseline) spent more time at sedentary activity levels than individuals who gained less weight, or had no weight change. Likewise, individuals who gained the most weight showed trends towards less moderate-vigorous activity. These results not only support the fourth physical activity hypothesis tested, but also highlight the importance of light physical activity in maintaining a healthy weight among children.

Because primary caregivers (mothers, fathers or grandparents) wore the accelerometers at the same time as their children, the relationship between primary caregiver and children's physical activity was examined. Among families in this study, there was no association between the primary caregiver's physical activity levels and their children's physical activity levels, and primary caregivers had significantly lower activity levels than their children. Likewise, the primary caregiver's physical activity levels were not associated with their children's weight status. These results do not support the fifth and sixth hypotheses tested. A contributing factor to this lack of association could be that although parents and children were wearing the accelerometers at the same time, they were likely engaged in different activities. For example, primary caregivers were at work or engaged in light household activities, while the children were either at home or at school. The difference in activities was observed. Among three families observed, children were observed playing outside in the yard while the primary caregiver spent large part of the day engaged in light household activities, sitting and watching television, light child care, and sitting in the house talking with extended relatives who were visiting.

Although the primary care givers had low activity levels compared to their children, it is possible that they facilitated their children's physical activity, either though encouraging children to be active, enrolling them in programs, or volunteering at their children's sporting events and recreational activities. This idea was supported by observations of families. For example, a stay at home mom continuously encouraged her girls to go outside and play, and because she was concerned about their safety walking to the nearby park; she had set aside a time each day to accompany her girls to the park. In another case, the primary caregiver worked nights, but spent days with his daughters during the summer; some of their daily activities included walking to the park and practicing softball. This parent also volunteered as the softball coach for his daughters' team, so in addition to making sure the girls got to practice, he encouraged them to practice during the day. Informal interviews with primary caregivers also indicated facilitating behaviors; parents would talk about how they had enrolled their kids in a summer gymnastics program, or they were helping to raise money for a soccer team trip. These observations support previous findings which suggest the positive influence of parental support on children's physical activity levels (Heitzler et al. 2006 and Brutsard 1993).

While primary caregiver physical activity levels did not predict their children's physical activity levels, having siblings did. Children with siblings accumulated more physical activity counts and spent more time at moderate-vigorous physical activity than children without siblings. These results are similar to those of Rausdsepp and Viira (2000), who found a positive correlation between siblings and physical activity levels. Among children in this study, siblings may impact physical activity in two ways. First, children have another person to play with, and one sibling may encourage the other to engage in physical activity through free play at home. This was observed among children in the study. In one case, two daughters in a family spent the largest part of their day engaged in free play in their yard; often running and playing tag. It is likely that these girls probably would not have spent as much time running, playing tag if they did not have another child to chase around the yard. Second, it is possible that having a sibling close in age or older who participates in an organized sport or recreational physical activities (running, cycling etc.) serves as a role model which encourages other siblings to do the same. This was also observed among families in the study. For example, in one family, the two older daughters played soccer; they were observed encouraging their younger sister to play with them and practice some of the new soccer tricks that they had just learned.

In summary, the physical activity of primary care givers was not related to their children's physical activity levels. However, primary caregivers may have facilitated physical activity among their children by encouraging them to play, or enrolling them in sports programs. The results do indicate the importance of siblings in physical activity levels. While the demographic data collected does not provide details about the relationship between siblings and physical activity, the observations indicate that siblings can influence physical activity by encouraging more free play at home, or modeling (participating in sports, encouraging younger siblings to participate in sports etc.).

Summary: weight status, diet and physical activity among children in the San Luis Valley

Almost half (47%) of the children in this sample were overweight or obese; this percentage is higher than the percentage reported for children living in Colorado between 2005 and 2006 (32.8%), as well as for children in 2007 (25% respectively) (Colorado Department of

Public Health and Environment 2006, 2007). While this sample may not be representative of all 9000 1-14 year old children living in the San Luis Valley, the results are similar to patterns observed among other children in the Valley, and may be and indicator that elementary school children in the Valley are be disproportionately affected by obesity.

The larger question here, however, is what is contributing to the high percentage of obesity among these children? In order to address this question, quantitative aspects of diet, physical activity and household characteristics were examined in this study. In addition, both informal and formal observations of household characteristics, school characteristics and community characteristics (grocery stores, number of restaurants, retail hours of operations, community events, recreation centers, park and open space availability) were used to provide context to the results of the quantitative data. In the end, both the quantitative and qualitative data suggested that energy intake patterns in beverage consumption and restaurant use were not associated with weight status among these children. Furthermore, the climate, school policy and layout of the communities seemed to minimize sweetened beverage consumption and restaurant use.

On the other hand, age and gender specific BMI percentiles and weight status were negatively correlated with physical activity levels, suggesting physical activity may play an important role in children maintaining a healthy weight. Furthermore, the results highlighted the importance of parents and siblings in facilitating physical activity. In summary, the school environment, household characteristics (beyond income) and the community layout all influenced children's food habits and physical activity patterns either positively or negatively.

Study Limitations and Lessons Learned

While this study has the potential to provide insight into the dietary and physical activity patterns among elementary school children living in rural communities, it also has some limitations. First, a major limitation to this study was the small sample size, which means that for some of the analyses, the statistical power was low. Therefore, it could be argued that some of results may not be representative of all children in the Valley. However, some of the results were obtained with acceptable power (0.80 or higher), and were supported by similar behaviors and patterns observed among other children and adults (non-Healthy Family Project participants) in the Valley, as well as patterns observed in the elementary schools. Thus, the results presented in this study may still be a useful indicator of general dietary and physical activity patterns in the Valley.

In addition to a small size, the sample may have been slightly biased in that the individuals studied were from families participating in the San Luis Valley Healthy Family Project. While informal observations of other children in the Valley were similar to the results presented here, it is possible that participation in an intervention study may have influenced some of the results. First, the household income for the sample was higher than the median income for the San Luis Valley. While there were some low income families participating in the study, it is possible that families with higher incomes, who felt that they had more time to participate in a research study enrolled in the study. Second, the relatively low energy intakes and low sweetened beverage consumption among the children may have also been partly related to families agreeing to participate in an intervention study. Families enrolled in the project because they had one member at risk for type II diabetes, and had the potential to be randomized into the experimental group which received home based lifestyle coaching. Therefore, it is likely that families entered the program with some interest in weight loss, healthy eating or improving physical activity. It is possible that children, knowing that they were in a study related to healthy eating and physical activity, adjusted their diet just before they were interviewed in the clinic. It is also possible that families came into the study, with some diet and physical activity behaviors in place. For example, some parents may have had opinions and rules about fast-food, sweetened beverages and snacking prior to entering the study. Nevertheless, the study did provide some insight and contextual information about dietary and physical activity behaviors among children and the results are similar to patterns observed among non-participating children in the Valley. Finally, although the Healthy Family Project sample was small, it included children from all over the Valley.

Despite the limitations imposed by the small sample size and participation in a larger intervention study, this study had benefits which may help in the design of future studies. For example, observations of children indicated that children accumulate moderate-vigorous activity bouts differently than adults, and suggest that 1-minute epochs on an accelerometer may be too long of an interval to capture the rapid changes children's physical activity patterns. These results combined with newer designed accelerometers that can be set to shorter intervals, could provide a clearer picture of activity patterns among children in this population. Furthermore, informal interviews with community member, elementary school observations as well as the subsample of observations that were combined with accelerometer data highlighted the importance of using ethnographic data and observational data together to assess physical activity among children. It was noted after the observations that some methods for defining activity levels by counts may overestimate children's activity levels. In addition, the observations provided context to the data collected by the accelerometers and dietary recalls. For example, the cases of parents facilitating their children's physical activity cannot be observed through raw accelerometer data, but it was during observations, as well as informal conversations with parents. Similarly, beliefs about water and food consumption were not clear in the dietary recall data, but were directly observed and highlighted during interviews with adults from the community. These are just two examples of the details that did not come across in raw accelerometer and dietary data files, but were essential to understanding dietary and physical activity patterns among children in the Valley. In the end, many of the observations combined with data analyses left more questions, and there are still many details about diet, physical activity and weight status among children in the Valley that should be studied with larger samples in the future.

A final note: some lessons learned about recruiting children for a study

One of the original goals of this study was to recruit all of the 7-12 year olds in the Healthy Family Project for the supplemental observational study, just as they were finishing their 12-month clinic visits. Ideally, all of the children would have been observed for two full days, following their clinic visit. In the end, only five children agreed to participate in the supplemental study. There are a couple of potential explanations for the lack of participation. First, although I had moved to the Valley, and had a family tie to the Valley, it was difficult to recruit families in the beginning, and wasn't until later part of my stay that I was actually considered to be part of the community. Looking back, all of the data collectors for the Healthy Family Project were long term residents in the Valley and knew the participating families, or at least a relative of the participating families. On the other hand, a new researcher was perhaps seen as an outsider, and given the close community ties in the Valley; families were not wholly comfortable with an outsider coming into their homes, especially one that even the data collectors in the clinic did not know well. Likewise, some of the children who would have been observed during the school year may have felt uncomfortable explaining to their peers at school that they were being observed as part of a study that involved eating and physical activity. Some children may have seen this as a "stigma" in the school.

However, as previously discussed, I had moved to the Valley, spent several days and hours in many of the schools, volunteered at community and school activities (e.g Walk to School Day), lived in the community as part of the community and continue to visit and participate in community events (Community Health Assessment and Management Program, CHAMP), which provided the opportunity for informal observations in many different settings. Not only did this allow for informal observations, which supported the results, it also brought familiarity between the researcher (me) and community members, and increased the likelihood of recruiting more families to participate in future studies. It is quite probable that the sample size would be larger if the study was repeated now.

Another contributing factor to the lack of participation may have been in the timing for the supplemental study relative to the Healthy Family Project. In order to prevent any impact on the larger study (Healthy Family Project), observations for the supplemental study did not begin until a child finished his or her 12-month visit. Children were first invited to participate in the supplemental study when they came to the clinic for their 6-month visit, and then asked again at their 12-month visit. Some families were excited about the study at the 6-month visit, but lost interest by the 12-month clinic visit. It is possible that by the end of the Healthy Family Project, many of the families did not want to be involved in another study right after participating in a 12-month study which included; clinic visits, follow-up dietary recalls for the children, wearing an accelerometer, and for some of the families, up to 16 home visits by a lifestyle coach. Many of the families came across as being very busy, and they talked about how busy they were. Among these families, both parents worked and one or more of the children were involved in sports or afterschool activities. It is possible that parents were not thrilled about having a visitor with their family. For some, this could have been seen as an inconvenience, meaning that perhaps they felt like they had to clean their house and have proper meals prepared. In addition, a number of the children finished their 12-month clinic visit in the summer. Some of these families had local summer activities planned (camping, visiting grandparents, traveling out the Valley), which did not include having a researcher visit their home and spend time with their family. Likewise, some of the children were traveling out of state for the summer, either to visit a parent or extended relatives.

In summary, a larger part of this project involved a learning experience, in terms of recruiting techniques. Perhaps there could have been a preliminary structured interview that would have made families more comfortable, or the timing of the study could have been scheduled differently relative to the Healthy Family Project. Nevertheless, the observations in the schools, observations of the participants in the supplemental study, informal interviews with the parents, and just being part of the community provided some insight into factors influencing children's food and physical activity habits, as well as factors in the San Luis Valley that influence children's energy balance. Finally, the experiences in the schools, community and recruiting provided an important learning experience that not only provided some answers to the original research question, but also opened the door for new research questions dedicated to better understanding energy balance issues that children in the San Luis Valley face, but also information that will hopefully help improve the design of future studies.

Conclusion

Overweight and obesity among children in this study is high compared to the rest of the state, supporting previous reports that children in the San Luis Valley are disproportionately affected by obesity. Over a 12-month period, children in this sample, there were no overall significant changes in energy intake, dietary patterns or physical activity, suggesting that 12-months is not a long enough period observe secular changes among elementary school children. Among children in this sample, water intake is high and dietary patterns are similar to those which were reported prior to the obesity epidemic in the United States. Furthermore, there was no association between dietary patterns and weight status in this study. On the other hand, physical activity was strongly associated with weight status, suggesting a larger role in these children's energy balance. Furthermore, siblings were associated with higher physical activity levels among children in this sample, highlighting the importance family influence on children's physical activity. Finally, a number of different aspects of the community, school and household seemed to influence dietary and physical activity behaviors indicating that energy balance among children in the San Luis Valley is strongly influenced by a combination of community, school and household. This highlights the importance of addressing issues in all of these aspects of environment in future interventions and research projects.

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APPENDIX

APPENDIX 3.1:

HEALTHY EATING INDEX (HEI-2005) COMPONENT SCORING STANDARDS

Total Fruits (1)		Whole Grains (6)	
HEI Intake (Converted to 0.8 cup eq/1000 kcal)	Score	HEI Intake (Converted to 1.5oz eq/1000 kcal)	Score
0	0	0	0.0
0.1	0.6	0.1	0.3
0.2	1.2	0.2	0.7
0.3	1.9	0.3	1.0
0.4	2.5	0.4	1.3
0.5	3.1	0.5	1.7
0.6	3.7	0.6	2.0
0.7	4.4	0.7	2.3
0.8 or more	5	0.8	2.7
Total Vegetables		0.9	3.0
		1.1	3.7
Whole Fruit/ Dk. Green & 0range vegetables (2/4)		1.2	4.0
HEI Intake (Converted to 0.4 cup eq/1000 kcal)	Score	1.3	4.3
0	0	1.4	4.7
0.1	1.25	1.5	5.0
0.2	2.5		
0.3	3.75	MILK (7)	
0.4	5	HEI intake (Converted to 1.3 cup eq/1000 kcal)	Score
		0	0
Total Vegetables (3)		0.1	0.8
HEI Intake (Converted to 1.1 cup eq/1000)	Score	0.2	1.5
0	0.0	0.3	2.3
0.1	0.5	0.4	3.1
0.2	0.9	0.5	3.8
0.3	1.4	0.6	4.6
0.4	1.8	0.7	5.4
0.5	2.3	0.8	6.2
0.6	2.7	0.9	6.9
0.7	3.2	1	7.7
0.8	3.6	1.1	8.5
0.9	4.1	1.2	9.2
1	5.0	1.3	10.0
1.1	5.0		
		Meat and Beans (8)	
Total Grains (5)		HEI intake (Converted to 2.5 oz eq/1000 kcal)	Score
HEI Intake (Converted to 3oz eq./1000 kcal)	Score	0	0
0	0.0	0.1	0.4
0.1	0.2	0.2	0.8
0.2	0.3	0.3	1.2
0.3	0.5	0.4	1.6
0.4	0.7	0.5	2
0.5	0.8	0.6	2.4
0.6	1.0	0.7	2.8
0.7	1.2	0.8	3.2
0.8	1.3	0.9	3.6
0.9	1.5	1.1	4.4
1.1	1.8	1.2	4.8

Total Grains (5)		Meat and Beans (8)	
HEI Intake (Converted to 3oz eq./1000 kcal)	Score	HEI intake (Converted to 2.5 oz eq/1000 kcal)	Score
1.2	2.0	1.3	5.2
1.3	2.2	1.4	5.6
1.4	2.3	1.5	6
1.5	2.5	1.6	6.4
1.6	2.7	1.7	6.8
1.7	2.8	1.8	7.2
1.8	3.0	1.9	7.6
1.9	3.2	2	8
2	3.3	2.1	8.4
2.1	3.5	2.2	8.8
2.2	3.7	2.3	9.2
2.3	3.8	2.4	9.6
2.4	4.0	2.5	10
2.5	4.2		
2.6	4.3		
2.7	4.5		
2.8	4.7		
2.9	4.8	Sodium	
3	5.0	(HEI intake = g/1000kcal)	Score
OILS (9, coded as 17)		>=2	0
HEI Intake (Converted to 12g/1000kcal)	Score	1.9	0
0	0	1.8	1
1	0.8	1.7	2
2	1.6	1.6	3
3	2.4	1.5	4
4	3.2	1.4	5
5	4.0	1.3	6
6	4.8	1.2	7
7	5.6	1.1	8
8	6.4	1	8.5
9	7.2	0.9	9
10	8.8	0.8	9.5
11	9.6	<=0.7	10
12	10.0	Saturated Fat	
		(HEI Intake % of total kcal)	
		>=15	0
Sodium =((total sodium mg/1000)/total kcal)*1000 Saturated fat = ((g sat fat*9)/total kcal)*100 SOFAAS=(((total add sugar g)*4)+(solid fat g*9))/kcal)*100		14.5	0.8
		14	1.6
		13.5	2.4
		13	3.2
		12.5	4.0
		12	4.8
		11.5	5.6
		11	6.4
		10.5	7.2
		10	8
		9.5	8.2
		9	8.4
		8.5	8.8
		8	9.2
		7.5	9.6
		<=7	10

	SOFAAS	
	(HEI intake = % of total energy	score
	0	0
	48	1.25
	46	2.5
	44	3.75
	42	5
	40	6.25
	38	7.5
	36	8.75
	34	10
	32	11.25
	30	12.5
	28	13.75
	26	15
	24	16.25
	22	17.5
	<=20	20

Adapted from: Guenther PM, Reedy J, Krebs-Smith SM. 2008. Development of the Healthy Eating Index-2005. *J. Amer. Diet. Assoc.* 108:1896-1901.

APPENDIX 4.1.

FOOD CATEGORY DETAILS

Food Category	Description of foods included in category
Beverage, water	Includes all reported consumption of tap water or bottled water
Beverage, milk	milk consumed as a beverage and on cereal; nonfat, 1%, 2%, whole and chocolate.
Beverage, sweetened (sodas, kool-aid etc)	Any carbonated soda (e.g. Coke, Pepsi, Dr. Pepper) fountain, canned or bottled; sugar sweetened teas, powdered mix drinks (e.g. lemonade, kool-aid; sport drinks inlcuding Powerade, Gatorade and SoBe drinks.
Condiments (ketchup, mustard, BBQ sauce, ranch dressing)	All condiments reported as added to a sandwich, entrée or salad.
Vegetable, potatoes excluded	All vegetables excluding potatoes. Includes canned, fresh, frozen.
Fruit (whole, dried, 100% fruit juice)	All fruits, includes: canned, fresh, frozen.
Cereal	All cold cereals (e.g. Fruit Loops, Apple Jacks, Coco Puffs etc.), instant oatmeal, and instant grits
Crackers, chips, cookies	All pre-packaged crackers (e.g. saltines, Ritz, Oyster crackers); Chips (e.g. Lays potato chips, pretzels, Doritos, Cheetos); Pre-packaged cookies (e.g. Oreos, Famous Amos) and homemade cookies, any type.
Convienence (pre-packaged/frozen entrees)	Any pre-packaged, canned or frozen entrée. For example: Chef Boyardee spaghetti, Eggo waffles, Lean Cuisine frozen meals and Hot Pockets.
Bread, commercially baked	all commercially baked breads (e.g. wonder bread, hot dog buns, hamburger buns).
Potato	All potato types. Fried, baked, mashed, tater tots, french fries (not from restaurant).
Pasta/noodle dish	Includes: spaghetti, macaroni dishes, linguini, raviolu (not canned), lasagna, and ramen noodles.
Chicken (grilled, baked, fried)	Excludes any chicken dishes from KFC restaurants.
Beef (ground, roast, shredded, grilled)	All beef excluding restaurant foods
Desserts, cake type	Includes: cakes, pies, quick breads (e.g. banana or zucchini bread), brownies and muffins
Restaurant, KFC (all foods)	Includeds chicken and all sides purchased from KFC restaurants
Food Category	**Description of foods included in category**

Desserts, ice cream type	Includes: hard ice cream, soft-serve ice cream, ice cream cakes, sundaes, shakes and malts.
Candy (all types)	All types of candy(e.g.chocolates, hard candies, licorice, jelly beans)
Tortillas	Flour or corn tortillas not used as part of a Mexican Dish. Some children report tortillas instead of bread with their sandwiches.
Restaurant, Pizza	Includes pizza purchased at a Pizza restaurant, but excludes Pizza served at one elementary School, which had a contract with Dominos to serve pizza every Tuesday during the school year.
Restaurant, McDonald's (all foods)	Includes any sandwich, entrée or side purchased from McDonald's restaurants
Eggs (scrambled, fried, boiled)	All eggs reported, but not from a restaurant
Lunch meats	Includes all deli type lunch meats (turkey, ham, bologna, roast beef)
Mexican food dish (mixed ingredients: burrito, tamale, enchilada, taco)	All mixed ingredient mexican food dishes; excludes any from a restaurant
Pizza, made at home or school (not consumed at a restaurant)	Pizza consumed at home or school. Homemade, frozen, or pre-made at the grocery store deli and cooked at home. Includes pizza consumed at 1 school which contracted with Domino's pizza.
Pork (shredded, ribs, chops)	
Restaurant, Chinese food	Food from Hunan Chinese restaurant in Alamosa or Monte Vista.
Cheese, processed	Includes Cheese Whiz, American cheese singles and Velveeta.
Sandwich, peanut butter	Peanut butter or peanut butter and jelly sandwich.
Nuts, seeds, or peanut butter	Includes, whole or shelled almonds, walnuts, peanuts, pecans; sunflower seeds and peanut butter not reported as part of a sandwich.
Cheese (not processed)	Any hard cheese, including cheddar, mozzarella, goat cheese, provolone or swiss.
Dessert, jello or pudding type	Includes desserts made with fruit flavored gelatin or pudding.
Restaurant, Mexican Food (e.g. Calvillos)	Any mexican food entrée consumed at or as take-out from one of the Mexican restaurants in the Valley. Most commonly Calvillos, Baldos, Oscars, Ninos and Charros. Does not include Taco Bell.
Beans (baked, pinto or black)	Includes any type of beans consumed as an entrée or side, but not used as an ingredient in another dish (e.g. bean burrito) or from a restaurant.

Food Category	Description of foods included in category
Chili sauce , added to entrees	Red or green chile sauce added to another entrée or side dish.
Pancakes/waffles	Includes pancakes or waffles, homemade or made from a mix, but not frozen.
Restaurant, Burger King (all foods)	Any sandwich or side dish consumed at or as take-out from a Burger King Restaurant.
Sandwich, mixed meats and cheeses	Includes cold sandwiches with vegetables and cheese or lunch meats and cheese. Does not include any sandwich from a restaurant.
Beverage, unsweetened/diet	Includes: diet sodas, unsweetened tea or coffee, sugar-free sport drinks or powdered drink mixes.
Sandwich, grilled cheese	Includes hot sandiwches made with cheese and bread, or cheese, ham and bread.
Yogurt (sweetened Yoplait types)	Includes all sweetened yogurts (e.g. Dannon, Yoplait and Gogurt)
Restaurant, Subway (all foods)	Any sandwich or side dish consumed at or as take-out purchased from a Subway restaurant.
Spreads, butter, cream cheese, oils added	Includes any butter, cream cheese or oil added as a spread or condiment to another entrée or side dish.
Fish (tuna, cod, perch, trout)	Does not include fish consumed at or as take-out from a restaurant. Grilled, baked or fried.

APPENDIX 5.1.

PHYSICAL ACTIVITY RECORD FORM

Data Collection FORM B: Physical Activity Record
Minority Supplement to the Healthy Family Project

Date ___/___/___

Participant # _________

TIME	LOCATION	ADULT PRESENT/ ABSENT	FOOD PRESENT/ ABSENT	BODY POSITON	ACTIVITY CODE	ITENSITY	NOTES

Observer Initials: _________

Page ____ of ____

APPENDIX 5.2. SUMMARY OF PHYSICAL ACTIVITY OBSERVATIONS

Activity	Minutes	MEAN	SD	CV	Min. Count	Max. Count	Min. MET	Max. MET
animal Care	**7**	**1817**	**877**	**0**	**468**	**3346**	**2**	**5**
changing activities (in between)	**3**	**451**	**518**	**1**	**102**	**1047**	**2**	**3**
child care (caring for siblings)	**5**	**631**	**267**	**0**	**292**	**1018**	**2**	**3**
Dodgeball	**16**	**5067**	**2869**	**1**	**446**	**9457**	**2**	**12**
duck, duck goose tag (sitting, walking, running)	**6**	**2671**	**864**	**0**	**6**	**8465**	**2**	**11**
hide and seek (running)	**8**	**2882**	**1491**	**1**	**1018**	**5553**	**3**	**8**
kneeling (various activities)	**21**	**277**	**150**	**1**	**57**	**577**	**2**	**2**
Milling	**58**	**401**	**1358**	**3**	**2086**	**5096**	**4**	**7**
picking up a toy to play	**3**	**326**	**267**	**1**	**18**	**488**	**2**	**2**
playground play (PG w/play structures)	**68**	**1101**	**1455**	**1**	**12**	**8488**	**2**	**11**
playing kickball	**5**	**3866**	**3289**	**1**	**339**	**8892**	**2**	**11**
playing tag (includes run, walk, stand)	**99**	**2229**	**2402**	**1**	**38**	**11579**	**2**	**14**
playing with dog or cat	**19**	**1877**	**1127**	**1**	**619**	**6054**	**2**	**8**
riding a Razr scooter (on sidewalk)	**14**	**1130**	**701**	**1**	**386**	**3078**	**2**	**5**
sitting, outside holding cat or on toy	**10**	**208**	**172**	**1**	**9**	**536**	**2**	**2**
sitting, inside (at a table, helping sibs)	**7**	**187**	**206**	**1**	**16**	**536**	**2**	**2**
sitting, eating	**28**	**94**	**207**	**2**	**0**	**930**	**2**	**3**
sitting, eating and talking	**20**	**32**	**67**	**2**	**0**	**228**	**2**	**2**
sitting inside, talking (NOT EATING)	**13**	**205**	**238**	**1**	**0**	**641**	**2**	**2**
sitting inside, watching TV	**8**	**93**	**178**	**2**	**0**	**497**	**2**	**2**
Standing	**23**	**197**	**181**	**1**	**3**	**628**	**2**	**2**
standing and talking	**53**	**136**	**153**	**1**	**1**	**704**	**2**	**2**
standing up (getting up to do something else)	**7**	**820**	**461**	**1**	**234**	**1492**	**2**	**3**
throwing and catching a ball	**18**	**1662**	**781**	**0**	**335**	**3487**	**2**	**5**
walking (outside at park, concrete path)	**9**	**1382**	**529**	**0**	**255**	**1967**	**2**	**4**
walking (outside in yard, grass and dirt)	**8**	**1332**	**624**	**0**	**450**	**2253**	**2**	**4**
walking (inside house, through house)	**9**	**883**	**419**	**0**	**379**	**1477**	**2**	**3**
walking (outside, carrying small child)	**3**	**2366**	**291**	**0**	**2039**	**2596**	**4**	**4**
Running	**5**	**3501**	**430**	**0**	**3078**	**4104**	**5**	**6**
TOTAL MINUTES =	**548**							

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
1364	animal care, feeding milo, getting dog food	3.10723032
2371	animal care, feeding milo, getting dog food	4.15892098
3346	animal care, feeding milo, getting dog food	5.17719148
1052	animal care, walking inside with dog	2.78138376
1254	animal care, walking outside with dog	2.99234852
1514	animal care, walking outside with dog	3.26388732
468	animal care, putting leash on dog	2.17146584
102	changing activity, game stopped, milling around	1.78922276
205	changing activity, standing, starting another game	1.8967939
1047	changing activity, starting tag game,	2.77616186
507	child care, helping little brother in bathroom	2.21219666
708	child care, helping little brother in bathroom	2.42211704
1018	child care, picking little brother up	2.74587484
292	child care, standing, helping little brother	1.98765496
628	child care, taking little brother inside, walking slow	2.33856664
2086	dodgeball tag, running	3.86127268
2213	dodgeball, chasing ball	3.99390894
2312	dodgeball, chasing ball	4.09730256
4084	dodgeball, chasing ball	5.94794392
5096	dodgeball, chasing ball	7.00485648
5373	dodgeball, chasing ball	7.29414974
5693	dodgeball, chasing ball	7.62835134
6836	dodgeball, chasing ball	8.82207768
7584	dodgeball, chasing ball	9.60327392
8402	dodgeball, chasing ball	10.45757676

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
8766	dodgeball, chasing ball	10.83773108
8883	dodgeball, chasing ball	10.95992354
9457	dodgeball, chasing ball	11.55939766
3065	dodgeball, running	4.8837207
446	dodgeball, standing	2.14848948
615	dodgeball, standing	2.3249897
4604	dodgeball, tag, running	6.49102152
5684	dodgeball, tag, running	7.61895192
1037	duck duck goose tag, walking	2.76571806
6208	duck, duck goose tag, running	8.16620704
8465	duck, duck goose tag, running	10.5233727
6	duck, duck goose tag, sitting still	1.68896228
159	duck, duck goose tag, sitting	1.84875242
150	duck, duck goose tag, walking	1.839353
1018	hide and seek, running	2.74587484
1905	hide and seek, running	3.6722399
2515	hide and seek, running	4.3093117
2925	hide and seek, running	4.7375075
3397	hide and seek, running	5.23045486
4212	hide and seek, running	6.08162456
5553	hide and seek, running	7.48213814
1529	household, cleaning dishes	3.27955302
322	kneeling helping put shoes on	2.01898636
326	kneeling helping put shoes on	2.02316388
380	kneeling helping put shoes on	2.0795604
518	kneeling helping put shoes on	2.22368484

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al.)
577	kneeling helping put shoes on	2.28530326
179	kneeling playing with puzzle game	1.86964002
250	kneeling playing with puzzle game	1.943791
260	kneeling, changed back to coloring game	1.9542348
464	kneeling, changed back to coloring game	2.16728832
57	kneeling, coloring	1.74222566
66	kneeling, coloring	1.75162508
83	kneeling, coloring	1.76937954
127	kneeling, coloring	1.81533226
197	kneeling, coloring	1.88843886
275	kneeling, coloring	1.9699005
283	kneeling, coloring	1.97825554
458	kneeling, coloring	2.16102204
371	kneeling, coloring (scratch and color)	2.07016098
251	kneeling, digging out coloring game	1.94483538
86	kneeling, pointing at book on bookshelf	1.77251268
289	kneeling, unpackaging coloring game	1.98452182
528	lying down, stretched out coloring, milo ran in	2.23412864
104	milling	1.79131152
124	milling	1.81219912
132	milling	1.82055416
132	milling	1.82055416
148	milling	1.83726424
149	milling	1.83830862
149	milling	1.83830862
162	milling	1.85188556

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
181	milling	1.87172878
181	milling	1.87172878
199	milling	1.89052762
230	milling	1.9229034
244	milling	1.93752472
250	milling	1.943791
250	milling	1.943791
273	milling	1.96781174
281	milling	1.97616678
297	milling	1.99287686
305	milling	2.0012319
313	milling	2.00958694
313	milling	2.00958694
333	milling	2.03047454
408	milling	2.10880304
449	milling	2.15162262
458	milling	2.16102204
465	milling	2.1683327
545	milling	2.2518831
621	milling	2.33125598
650	milling	2.361543
678	milling	2.39078564
678	milling	2.39078564
696	milling	2.40958448
709	milling	2.42316142
155	milling around	1.8445749
577	milling around	2.28530326

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
236	milling around, showing me toys	1.92916968
319	milling around, showing me toys	2.01585322
375	milling around, showing me toys	2.0743385
482	milling around, showing me toys	2.18608716
522	milling around, showing me toys	2.22786236
602	milling around, showing me toys	2.31141276
1223	milling around, showing me toys	2.95997274
484	milling in living room	2.18817592
683	milling, getting breakfast, moving to table	2.39600754
212	milling, getting ice cream	1.90410456
953	milling, getting pizza	2.67799014
278	milling, getting ready to eat	1.97303364
255	milling, milling about getting a glass of milk	1.9490129
354	milling, milling about getting a glass of milk	2.05240652
456	milling, milling about yard with ball	2.15893328
559	milling, milling about yard with ball	2.26650442
662	milling, milling about yard with ball	2.37407556
565	milling, milling around	2.2727707
762	milling, milling around	2.47851356
463	milling, milling around, playing with cat	2.16624394
234	milling, playing with cat	1.92708092
245	milling, starting hide and seek game	1.9385691
485	milling, starting tag game	2.1892203
305	personal care, in house, washing hands	2.0012319
18	picking up a toy, getting kickball out	1.70149484
472	picking up a toy, outside, getting scooter out to play with	2.17564336
488	picking up a toy, picking up scooter	2.19235344

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
320	playground play out of swing to play structure	2.0168976
4460	playground play, changed mind, running to another structure	6.3406308
2970	playground play, climbing onto play structure	4.7845046
432	playground play, getting off of play structure	2.13386816
777	playground play, getting off of play structure	2.49417926
876	playground play, milling around on playstrucuture	2.59757288
101	playground play, milling around playstructure	1.78817838
210	playground play, milling around playstructure	1.9020158
380	playground play, milling around playstructure	2.0795604
453	playground play, milling around playstructure	2.15580014
1032	playground play, milling around playstructure	2.76049616
3672	playground play, moving on playstructure	5.51765936
706	playground play, playing on play structure	2.42002828
1357	playground play, playing on play structure	3.09991966
1375	playground play, playing on play structure	3.1187185
1665	playground play, playing on play structure	3.4215887
1677	playground play, playing on play structure	3.43412126
2623	playground play, playing on play structure, walking, climbing	4.42210474
4628	playground play, playing on play structure, walking, climbing	6.51608664
2550	playground play, running to and climbing on another playstructure	4.345865
2676	playground play, running to and climbing on another playstructure	4.47745688
2032	playground play, running to playground	3.80487616
2403	playground play, running to playground	4.19234114
2903	playground play, running to swings	4.71453114
93	playground play, sitting on playstructure	1.77982334
147	playground play, sitting on playstructure	1.83621986

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
320	playground play, sitting on playstructure	2.0168976
66	playground play, standing at slide	1.75162508
257	playground play, standing at slide	1.95110166
851	playground play, standing on playstructure	2.57146338
936	playground play, standing on playstructure, talking	2.66023568
696	playground play, standing pushing little brother on swings	2.40958448
13	playground play, standing, leaning on playstructure	1.69627294
24	playground play, standing, leaning on playstructure	1.70776112
64	playground play, standing, leaning on playstructure	1.74953632
88	playground play, standing, milling, talking to kids on structure	1.77460144
161	playground play, standing, milling, talking to kids on structure	1.85084118
215	playground play, standing, milling, talking to kids on structure	1.9072377
224	playground play, standing, milling, talking to kids on structure	1.91663712
287	playground play, standing, milling, talking to kids on structure	1.98243306
237	playground play, standing, pushing little brother on swings	1.93021406
12	playground play, standing, talking on play structure	1.69522856
23	playground play, standing, talking on play structure	1.70671674
30	playground play, standing, talking on play structure	1.7140274
31	playground play, standing, talking on play structure	1.71507178
31	playground play, standing, talking on play structure	1.71507178
31	playground play, standing, talking on play structure	1.71507178
36	playground play, standing, talking on play structure	1.72029368
43	playground play, standing, talking on play structure	1.72760434
48	playground play, standing, talking on play structure	1.73282624
52	playground play, standing, talking on play structure	1.73700376
87	playground play, standing, talking on play structure	1.77355706
166	playground play, standing, talking on play structure	1.85606308

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
197	playground play, standing, talking on play structure	1.88843886
266	playground play, standing, talking on play structure	1.96050108
329	playground play, standing, talking on play structure	2.02629702
522	playground play, standing, talking on play structure	2.22786236
650	playground play, standing, talking on play structure	2.361543
2140	playground play, swinging on swingset	3.9176692
8488	playground play, swinging on swingset	10.54739344
2717	playground play, walking across playstructure	4.52027646
1368	playground play, walking from playstructure to swings	3.11140784
2343	playground play, walking to monkey bars	4.12967834
1333	playground play, walking to other playground equipment	3.07485454
1754	playground play, walking, playing on playstructure	3.51453852
1784	playground play, walking, playing on playstructure	3.54586992
1578	playground play, walking, playing with younger siblings on play structure	3.33072764
1869	playground play, walking, playing with younger siblings on play structure	3.63464222
2319	playing kickball, running	4.10461322
2627	playing kickball, running	4.42628226
5152	playing kickball, running	7.06334176
8892	playing kickball, running	10.96932296
339	playing kickball, walking	2.03674082
38	playing tag (run, walk, stand, run)	1.72238244
52	playing tag (run, walk, stand, run)	1.73700376
77	playing tag (run, walk, stand, run)	1.76311326
105	playing tag (run, walk, stand, run)	1.7923559
121	playing tag (run, walk, stand, run)	1.80906598

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
133	playing tag (run, walk, stand, run)	1.82159854
138	playing tag (run, walk, stand, run)	1.82682044
152	playing tag (run, walk, stand, run)	1.84144176
177	playing tag (run, walk, stand, run)	1.86755126
200	playing tag (run, walk, stand, run)	1.891572
277	playing tag (run, walk, stand, run)	1.97198926
320	playing tag (run, walk, stand, run)	2.0168976
383	playing tag (run, walk, stand, run)	2.08269354
399	playing tag (run, walk, stand, run)	2.09940362
399	playing tag (run, walk, stand, run)	2.09940362
401	playing tag (run, walk, stand, run)	2.10149238
403	playing tag (run, walk, stand, run)	2.10358114
417	playing tag (run, walk, stand, run)	2.11820246
429	playing tag (run, walk, stand, run)	2.13073502
499	playing tag (run, walk, stand, run)	2.20384162
520	playing tag (run, walk, stand, run)	2.2257736
520	playing tag (run, walk, stand, run)	2.2257736
547	playing tag (run, walk, stand, run)	2.25397186
598	playing tag (run, walk, stand, run)	2.30723524
604	playing tag (run, walk, stand, run)	2.31350152
607	playing tag (run, walk, stand, run)	2.31663466
616	playing tag (run, walk, stand, run)	2.32603408
627	playing tag (run, walk, stand, run)	2.33752226
643	playing tag (run, walk, stand, run)	2.35423234
660	playing tag (run, walk, stand, run)	2.3719868
660	playing tag (run, walk, stand, run)	2.3719868
711	playing tag (run, walk, stand, run)	2.42525018

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
720	playing tag (run, walk, stand, run)	2.4346496
771	playing tag (run, walk, stand, run)	2.48791298
824	playing tag (run, walk, stand, run)	2.54326512
858	playing tag (run, walk, stand, run)	2.57877404
864	playing tag (run, walk, stand, run)	2.58504032
868	playing tag (run, walk, stand, run)	2.58921784
902	playing tag (run, walk, stand, run)	2.62472676
903	playing tag (run, walk, stand, run)	2.62577114
953	playing tag (run, walk, stand, run)	2.67799014
980	playing tag (run, walk, stand, run)	2.7061884
1032	playing tag (run, walk, stand, run)	2.76049616
1141	playing tag (run, walk, stand, run)	2.87433358
1175	playing tag (run, walk, stand, run)	2.9098425
1270	playing tag (run, walk, stand, run)	3.0090586
1374	playing tag (run, walk, stand, run)	3.11767412
1388	playing tag (run, walk, stand, run)	3.13229544
1392	playing tag (run, walk, stand, run)	3.13647296
1415	playing tag (run, walk, stand, run)	3.1604937
1446	playing tag (run, walk, stand, run)	3.19286948
1463	playing tag (run, walk, stand, run)	3.21062394
1584	playing tag (run, walk, stand, run)	3.33699392
1626	playing tag (run, walk, stand, run)	3.38085788
1699	playing tag (run, walk, stand, run)	3.45709762
1738	playing tag (run, walk, stand, run)	3.49782844
1782	playing tag (run, walk, stand, run)	3.54378116
1858	playing tag (run, walk, stand, run)	3.62315404
1940	playing tag (run, walk, stand, run)	3.7087932

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
2000	playing tag (run, walk, stand, run)	3.771456
2455	playing tag (run, walk, stand, run)	4.2466489
2534	playing tag (run, walk, stand, run)	4.32915492
2596	playing tag (run, walk, stand, run)	4.39390648
2831	playing tag (run, walk, stand, run)	4.63933578
2919	playing tag (run, walk, stand, run)	4.73124122
2990	playing tag (run, walk, stand, run)	4.8053922
3725	playing tag (run, walk, stand, run)	5.5730115
3845	playing tag (run, walk, stand, run)	5.6983371
3973	playing tag (run, walk, stand, run)	5.83201774
4576	playing tag (run, walk, stand, run)	6.46177888
4613	playing tag (run, walk, stand, run)	6.50042094
4808	playing tag (run, walk, stand, run)	6.70407504
4992	playing tag (run, walk, stand, run)	6.89624096
5571	playing tag (run, walk, stand, run)	7.50093698
5708	playing tag (run, walk, stand, run)	7.64401704
5727	playing tag (run, walk, stand, run)	7.66386026
5763	playing tag (run, walk, stand, run)	7.70145794
6818	playing tag (run, walk, stand, run)	8.80327884
7681	playing tag (run, walk, stand, run)	9.70457878
11579	playing tag (run, walk, stand, run)	13.77557202
1201	playing tag (running, stand, walking)	2.93699638
2254	playing tag (running, stand, walking)	4.03672852
2343	playing tag (running, stand, walking)	4.12967834
5613	playing tag (running, stand, walking)	7.54480094
2269	playing tag, tag game with mom,	4.05239422
6692	playing tag, tag game with mom,	8.67168696

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
601	playing tag, tag with sister	2.31036838
926	playing tag, tag with sister	2.64979188
1236	playing tag, tag with sister	2.97354968
1906	playing tag, tag with sister	3.67328428
2202	playing tag, tag with sister	3.98242076
3656	playing tag, tag with sister	5.50094928
4080	playing tag, tag with sister	5.9437664
4236	playing tag, tag with sister	6.10668968
4542	playing tag, tag with sister	6.42626996
6864	playing tag, tag with sister	8.85132032
7515	playing tag, tag with sister	9.5312117
7590	playing tag, tag with sister	9.6095402
10839	playing tag, tag with sister	13.00273082
1430	playing with cat, catching, picking up neighbor's cat	3.1761594
1499	playing with cat, picking up, and carrying cat	3.24822162
1485	playing with dog in yard	3.2336003
1230	playing with dog, playing fetch with dog in yard	2.9672834
1652	playing with dog, playing fetch with dog in yard	3.40801176
1261	playing with dog, playing fetch, chase with dog	2.99965918
1611	playing with dog, playing fetch, chase with dog	3.36519218
2574	playing with dog, playing fetch, chase with dog	4.37093012
6054	playing with dog, playing fetch, chase with dog	8.00537252
2374	playing with dog, playing with dog outside	4.16205412
1462	playing with dog, playing with milo	3.20957956
619	playing with dog, standing playing with dog	2.32916722
1066	playing with dog, standing, playing with dog	2.79600508
1237	playing with dog, walking around, playing fetch with Milo	2.97459406

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
2144	playing with dog, walking around, playing fetch with Milo	3.92184672
2170	playing with dog, walking around, playing fetch with Milo	3.9490006
2350	playing with dog, walking around, playing fetch with Milo	4.136989
1800	playing with dogplaying with dog in yard	3.56258
1636	playing with playing with dog in yard	3.39130168
596	playing with puzzle game	2.30514648
3369	playing with sister and neighbor in yard	5.20121222
802	razr scooter, set scooter down, playing with sister	2.52028876
322	riding scooter	2.01898636
386	riding scooter	2.08582668
562	riding scooter	2.26963756
704	riding scooter	2.41793952
711	riding scooter	2.42525018
761	riding scooter	2.47746918
765	riding scooter	2.4816467
994	riding scooter	2.72080972
1012	riding scooter	2.73960856
1202	riding scooter	2.93804076
1039	riding scooter, playing with dog	2.76780682
1199	riding scooter, razr scooter	2.93490762
1267	riding scooter, razr scooter	3.00592546
2138	riding scooter, razr scooter	3.91558044
3078	running, running around other side of house to get ball	4.89729764
3250	running, running around other side of house to get ball	5.076931
3793	running, running around other side of house to get ball	5.64402934
4104	running, running around other side of house to get ball	5.96883152
3280	running, running inside to take off accelerometer	5.1082624

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
320	siiting in grass	2.0168976
43	siting holding cat	1.72760434
9	sitting	1.69209542
241	sitting	1.93439158
107	sitting playing with cat	1.79444466
129	sitting playing with cat	1.81742102
72	sitting, sitting playing with cat (holding cat)	1.75789136
414	sitting, sitting in grass	2.11506932
208	sitting, sitting on toy	1.89992704
536	sitting, sitting on toy (plastic stand)	2.24248368
16	sitting, done eating	1.69940608
4	sitting, drinking milk watching tv	1.68687352
364	sitting, eating, sitting in yard eating ice cream	2.06285032
100	sitting, at table finished eating talking	1.787134
2	sitting, sitting at table	1.68478476
325	sitting, sitting at table and helping siblings	2.0221195
501	sitting, sitting at table, helping siblings	2.20593038
0	sitting, sitting eating	1.682696
0	sitting, sitting eating	1.682696
0	sitting, sitting eating	1.682696
0	sitting, sitting eating	1.682696
0	sitting, sitting eating	1.682696
0	sitting, sitting eating	1.682696
0	sitting, sitting eating	1.682696
1	sitting, sitting eating	1.68374038
2	sitting, sitting eating	1.68478476
2	sitting, sitting eating	1.68478476

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
3	sitting, sitting eating	1.68582914
6	sitting, sitting eating	1.68896228
7	sitting, sitting eating	1.69000666
9	sitting, sitting eating	1.69209542
11	sitting, sitting eating	1.69418418
13	sitting, sitting eating	1.69627294
17	sitting, sitting eating	1.70045046
26	sitting, sitting eating	1.70984988
29	sitting, sitting eating	1.71298302
31	sitting, sitting eating	1.71507178
46	sitting, sitting eating	1.73073748
84	sitting, sitting eating	1.77042392
84	sitting, sitting eating	1.77042392
185	sitting, sitting eating	1.8759063
221	sitting, sitting eating	1.91350398
366	sitting, sitting eating	2.06493908
546	sitting, sitting eating	2.25292748
930	sitting, sitting eating	2.6539694
0	sitting, sitting eating, talking (TV is on)	1.682696
0	sitting, sitting eating, talking (TV is on)	1.682696
0	sitting, sitting eating, talking (TV is on)	1.682696
0	sitting, sitting eating, talking (TV is on)	1.682696
0	sitting, sitting eating, talking (TV is on)	1.682696
0	sitting, sitting eating, talking (TV is on)	1.682696
0	sitting, sitting eating, talking (TV is on)	1.682696
1	sitting, sitting eating, talking (TV is on)	1.68374038
1	sitting, sitting eating, talking (TV is on)	1.68374038

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
1	sitting, sitting eating, talking (TV is on)	1.68374038
2	sitting, sitting eating, talking (TV is on)	1.68478476
2	sitting, sitting eating, talking (TV is on)	1.68478476
3	sitting, sitting eating, talking (TV is on)	1.68582914
3	sitting, sitting eating, talking (TV is on)	1.68582914
8	sitting, sitting eating, talking (TV is on)	1.69105104
9	sitting, sitting eating, talking (TV is on)	1.69209542
91	sitting, sitting eating, talking (TV is on)	1.77773458
107	sitting, sitting eating, talking (TV is on)	1.79444466
188	sitting, sitting eating, talking (TV is on)	1.87903944
228	sitting, sitting eating, talking (TV is on)	1.92081464
21	sitting, sitting talking	1.70462798
30	sitting, sitting talking	1.7140274
41	sitting, sitting talking	1.72551558
44	sitting, sitting talking	1.72864872
50	sitting, sitting talking	1.734915
122	sitting, sitting talking	1.81011036
149	sitting, sitting talking	1.83830862
165	sitting, sitting talking	1.8550187
225	sitting, sitting talking	1.9176815
585	sitting, sitting talking	2.2936583
641	sitting, sitting talking	2.35214358
0	sitting, talking	1.682696
590	sitting, talking	2.2988802
0	sitting, watching tv	1.682696
0	sitting, watching tv	1.682696
0	sitting, watching tv	1.682696

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
0	sitting, watching tv	1.682696
11	sitting, watching tv	1.69418418
30	sitting, watching tv	1.7140274
209	sitting, watching tv	1.90097142
497	sitting, watching tv	2.20175286
29	standing	1.71298302
59	standing	1.74431442
83	standing	1.76937954
119	standing	1.80697722
128	standing	1.81637664
150	standing	1.839353
169	standing	1.85919622
174	standing	1.86441812
190	standing	1.8811282
278	standing	1.97303364
284	standing	1.97929992
336	standing	2.03360768
357	standing	2.05553966
381	standing	2.08060478
596	standing	2.30514648
628	standing	2.33856664
62	standing	1.74744756
77	standing	1.76311326
389	standing	2.08895982
6	standing, still	1.68896228
3	standing still	1.68582914
8	standing still	1.69105104

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
28	standing still	1.71193864
46	standing still, showing me doll collection	1.73073748
37	standing still, talking	1.72133806
145	standing up, getting up	1.8341311
55	standing and pointing	1.7401369
31	standing pouring juice (HC)	1.71507178
0	standing, putting dishes in sink	1.682696
234	standing up, getting up, getting bottle for 2yr old out of fridge	1.92708092
777	standing up, stood up, youngest sib asked for help	2.49417926
615	standing up, getting up from table, standing	2.3249897
1030	standing up, getting up, getting puzzle game	2.7584074
1492	standing up, getting up, walking outside	3.24091096
352	standing up, walking out door	2.05031776
1238	standing up, walking to park	2.97563844
110	standing, fidgeting	1.7975778
213	standing, fidgeting	1.90514894
255	standing, fidgeting	1.9490129
826	standing, fidgeting	2.54535388
255	standing, playing with little sister	1.9490129
407	standing, playing with little sister	2.10775866
460	standing, standing talking	2.1631108
8	standing talking	1.69105104
37	standing talking	1.72133806
1	standing, talking	1.68374038
11	standing, talking	1.69418418
12	standing, talking	1.69522856

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
13	standing, talking	1.69627294
15	standing, talking	1.6983617
15	standing, talking	1.6983617
16	standing, talking	1.69940608
23	standing, talking	1.70671674
25	standing, talking	1.7088055
26	standing, talking	1.70984988
32	standing, talking	1.71611616
35	standing, talking	1.7192493
42	standing, talking	1.72655996
48	standing, talking	1.73282624
48	standing, talking	1.73282624
49	standing, talking	1.73387062
54	standing, talking	1.73909252
58	standing, talking	1.74327004
59	standing, talking	1.74431442
66	standing, talking	1.75162508
69	standing, talking	1.75475822
74	standing, talking	1.75998012
79	standing, talking	1.76520202
80	standing, talking	1.7662464
110	standing, talking	1.7975778
113	standing, talking	1.80071094
114	standing, talking	1.80175532
119	standing, talking	1.80697722
123	standing, talking	1.81115474
126	standing, talking	1.81428788

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
133	standing, talking	1.82159854
146	standing, talking	1.83517548
148	standing, talking	1.83726424
166	standing, talking	1.85606308
169	standing, talking	1.85919622
196	standing, talking	1.88739448
222	standing, talking	1.91454836
224	standing, talking	1.91663712
244	standing, talking	1.93752472
261	standing, talking	1.95527918
339	standing, talking	2.03674082
531	standing, talking	2.23726178
704	standing, talking	2.41793952
559	standing, talking, getting ready to play	2.26650442
117	standing, talking, moving	1.80488846
50	standing, talking, playing game	1.734915
54	standing, talking, playing name game	1.73909252
136	standing, talking	1.82473168
335	throwing a ball (catch with sister)	2.0325633
536	throwing a ball (catch with sister)	2.24248368
586	throwing a ball (catch with sister)	2.29470268
1526	throwing a ball (catch with sister)	3.27641988
1635	throwing a ball (catch with sister)	3.3902573
1906	throwing a ball (catch with sister)	3.67328428
2341	throwing a ball (catch with sister)	4.12758958
2735	throwing a ball (trying to get it over the roof)	4.5390753
1117	throwing a ball, (playing catch)catching ball	2.84926846

APPENDIX 5.3. PARTICIPANT #1686 PHYSICAL ACTIVITY OBSERVATION DATA witrh CPM and METS

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
1163	throwing a ball, playing catch with sister	2.89730994
1647	throwing a ball, playing catch with sister	3.40278986
1759	throwing a ball, playing catch with sister	3.51976042
1801	throwing a ball, playing catch with sister	3.56362438
1872	throwing a ball, playing catch with sister	3.63777536
1984	throwing a ball, playing catch with sister	3.75474592
3487	throwing a ball, throwing ball from other side	5.32444906
2206	throwing a ball, throwing ball over roof	3.98659828
1275	throwing ball (trying to get it over the roof)	3.0142805
1285	walking	3.0247243
543	walking, brother down, walking slow	2.24979434
924	walking, getting ready to leave to walk home	2.64770312
1440	walking, moving toys around	3.1866032
1447	walking, moving toys around	3.19391386
669	walking, off scooter, walking into house	2.38138622
2224	walking, playing	4.00539712
1468	walking, playing hiding game	3.21584584
1544	walking, playing hiding game	3.29521872
2025	walking, playing hiding game, hiding object	3.7975655
1067	walking, playing hiding game, picking up toys	2.79704946
255	walking, taking brother to bathroom (outside on path)	1.9490129
1319	walking, walking home (outside on path)	3.06023322
1478	walking, walking home (outside on path)	3.22628964
1504	walking, walking home (outside on path)	3.25344352
1511	walking, walking home (outside on path)	3.26075418
1967	walking, walking home (outside on path)	3.73699146
1572	walking, walking to park (outside on path)	3.32446136

COUNTS (1min intervals)	ACTIVITY DESCRIPTION	MET (Freedson et al. 1997)
1936	walking, walking to park (outside on path)	3.70461568
895	walking, walking with mom, and younger siblings (outside on path)	2.6174161
1884	walking, walking into yard (outside, through grass)	3.65030792
1514	walking, walking to other side of house (outside on grass)	3.26388732
1749	walking, walking across yard to go inside	3.50931662
450	walking, walking across yard	2.152667
774	walking, walking across yard	2.49104612
1212	walking, walking after ball (through grass, in yard)	2.94848456
820	walking, walking around, outside, yard	2.5390876
2253	walking, walking fast after cat	4.03568414
1477	walking, walking fast into house into kitchen	3.22524526
1334	walking, walking acrross room	3.07589892
767	walking, walking back outside to yard with a ball	2.48373546
1346	walking, walking outside to yard (through house)	3.08843148
379	walking, walking in house for lunch (through house)	2.07851602
421	walking, walking back to table	2.12237998
987	walking, walking into house	2.71349906
602	walking, walking through the house	2.31141276
632	walking, walking to kitchen (through house)	2.34274416
2039	walking/carrying little brother	3.81218682
2596	walking/carrying little brother	4.39390648
2462	walking/carrying little brother back to playground	4.25395956

APPENDIX 7.1:

HFP Accelerometer Data Processing Notes

Complied by: Sharon Scarbro, Colorado School of Public Health, 10/20/2009

Overview

Accelerometer data was collected on all subjects after both the baseline and 12 month clinic visit. The participants were to wear the monitors for 7 days after which time the participants returned the monitors to the clinic and the data downloaded. When the data is downloaded a ".dat" file is created that contains the start day and time, download day and time, monitor serial number, what epoch setting the monitor was set to (1 for all subjects) and counts of activity in 1 (epoch) minute intervals. The ".dat" file for each monitor was then run through programs developed by NCI and adjusted by Mary Dinger to come up the amount of physical activity per day and on average (see NCI processing below for details). The NCI programs require the start date the monitor should be worn and age if a child. See below for notes on determining start date. The NCI programs also require that the format of the ".dat" files be changed to 3 columns of data and in a csv format. The program ActiLife (part of ActiGraph) which we received from Mary Dinger does this.

NCI Processing

A valid day was defined as having 10 or more hours of monitor wear. Wear time was determined by subtracting nonwear time from 24 hours. Nonwear was defined by an interval of at least 60 consecutive minutes of zero activity intensity counts, with allowance for 1–2 minutes of counts between 0 and 100. Four or more valid days was needed to constitute valid accelerometer data.

Response

There were 1182 total baseline (n=625) and 12 month (n=557) visits. Of those there were 1011 (85%) accelerometer “.dat” files. Of the 171 visits with no “.dat” file 51 visits indicated “no data” or “no epoch” on the inventory log, 82 participants had either “refused”, “didn’t wear” or “moved” indicated on the participant log(n=80) or the inventory log (n=2), 34 visits were never entered on the inventory log, 2 monitors were lost/stolen and 2 “.dat” files are missing with no explanation. Of the 625 baseline visits 487 (78%) had valid accelerometer data, 84 (13%) had acc. data but did not meet above criteria and 54 (9%) had no acc data. . Of the 557 12 month visits 332 (60%) had valid accelerometer data, 107 (19%) had acc. data but did not meet above criteria and 118 (21%) had no acc data.

Determining Start Date

Background: Start date is the date the participant is to begin wearing the monitor. Start date can be found on the monitor inventory log that logs monitors going in and out, on the participant’s log sheet and from the monitor itself. According to the Accelerometer protocol the monitor start date is the day after the participant’s clinic visit. However, for some participants the start did not occur on the scheduled day. The reasons for this were as follows (per conversation with Rose):

a) Early on there were not enough monitors so participants had to wait for a monitor to be returned.
b) Monitors were not distributed until all family members completed “usual care” education or declined education.
c) If participant was not going to have a “usual” week, for instance going on vacation, then monitors were distributed when participant returned.
d) There was no data on original week so reissued another monitor
e) One or more participants within a family did not come in with the rest of the family and monitors for the whole family were issued when the last family member attended clinic (from Sharon’s looking at data, not Rose)

Cleaning Process: The start date was abstracted from all the “dat” files and input into a SAS dataset. A “dat” file is produced when data is downloaded from the monitor. The “dat” file also contains the date and time the monitor was downloaded. This file was merged by id and visit type to the clinic visit data and the monitor start date was compared to the calculated start date based on visit date. Of 1011 total visits with monitor data, 97 visits did not have a start date that matched their visit date. The list below includes visits for these participants along with notes.

Explanation of column headings:

Startmatch:	“OFF” if monitor start date was not the same as protocol start date.
Startdate:	start date from monitor data
Prstartdate:	Protocol start date (i.e. day after clinic data collection visit date)
Visdate:	clinic data collection visit date
F2r:	dat file name
Starttime:	start time from monitor
Directory:	directory dat file was abstracted from
Visit_id:	Visit type: 4=baseline, 6=12 month

“Inv” refers to the monitor inventory, “Log” refers to the participant log and “Acc” refers to the monitor data, “SD” stands for start date. Yellow highlight indicates suggested start date or action. These actions were put into effect after review (10/1/09).

When monitor inventory log (Trina’s log) was the same as the start date recorded on the monitor but the visit date did not match, it was assumed that one of the above reasons (a-e) was in effect. The participant log sheet was reviewed to confirm this decision and the start date on the participants log sheet was used.

List of participants where the protocol start date is not the monitor's start date. PASS 1

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_ id
1	1002-01		05/11/05	05/11/2005	05/10/2005	10020144.dat	8:00:00	2005	4
2	1002-01		06/02/06	06/02/2006	06/01/2006	10020194a.dat	8:00:00	2006	6
3	1002-01	OFF	06/06/06	.	.	10020194b.dat	11:45:00	2006	99
	Surmising brought back monitor too early, downloaded and sent back out with same monitor. No inventory notes, Log from 6/2-6/8. Need to put two files a and b together to get 7 days.								
4	1002-03	OFF	05/13/05	05/11/2005	05/10/2005	10020349.dat	8:00:00	2005	4
	Inv: SD 5/13, no notes Log: SD 5/13 no notes								
5	1002-03		06/02/06	06/02/2006	06/01/2006	10020334.dat	8:00:00	2006	6
6	1012-01		07/16/05	07/16/2005	07/15/2005	10120147a.dat	8:00:00	2005	4
7	1012-01		11/23/06	11/23/2006	11/22/2006	10120148.dat	8:00:00	2006	6
8	1012-01	OFF	08/09/05	.	.	10120132b.dat	8:00:00	2005	99
	2 acc dat files (a SD: 7/16 and b SD: 8/9), Inv: note "1st monitor had error ". Log SD 8/9. Use b file with start date of 8/9/05								
9	1023-02	OFF	10/29/05	10/08/2005	10/07/2005	10230243.dat	8:41:01	2005	4
	Inv: SD 10/8, ? returned, download date 10/29 Monitor: Download date is 10/29 and time is before start time. No log sheets. See 1103-02 below. Set SD to 10/29.								
10	1023-02		.	01/13/2007	01/12/2007		.	.	6
11	1103-02	OFF	01/28/06	01/05/2006	01/04/2006	11030238SN.dat	8:00:00	2006	4

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_ id
	Inv: 1/5 note-"data 1/10-2/15, Log: SD 1/5, data looks ok, epoch recovery. Thinking monitor start date got messed up when did epoch recovery and should set start date to 1/28 to pick up data that reflects SD 1/5.								
12	1403-03		11/01/06	11/01/2006	10/31/2006	14030346.dat	8:00:00	2006	4
13	1403-03	OFF	12/11/07	12/06/2007	12/05/2007	14030354.dat	8:00:00	2007	6
	Inv: SD 12/11 no notes, no Log sheet								
14	1537-01		03/08/06	03/08/2006	03/07/2006	15370148.dat	8:00:00	2006	4
15	1537-01	OFF	06/16/07	05/09/2007	05/08/2007	15370135.dat	8:00:01	2007	6
	Inv: SD 6/16 no notes, Log SD6/18-6/24 no notes								
16	1537-02		03/08/06	03/08/2006	03/07/2006	15370235.dat	8:00:00	2006	4
17	1537-02	OFF	06/16/07	05/09/2007	05/08/2007	15370247.dat	8:00:01	2007	6
	Inv: SD 6/16 no notes, Log SD6/18-6/22 no notes								
18	1541-01		03/10/06	03/10/2006	03/09/2006	15410142.dat	8:00:00	2006	4
19	1541-01	OFF	12/05/07	04/13/2007	04/12/2007	15410192.dat	8:00:00	2007	6
	2 files 15410147 SD: 4/13 and 15410192 SD:12/5 Inv: shows 2 monitors SD: 4/13 and 12/5, Log SD 4/13. No visit 12/4. Use 15410147 SD:4/13 file								
20	1541-02		03/10/06	03/10/2006	03/09/2006	15410232.dat	8:00:00	2006	4
21	1541-02	OFF	12/05/07	04/13/2007	04/12/2007	15410246.dat	8:00:00	2007	6
	2 files 15410242 SD: 4/13 and 15410246 SD:12/5 Inv: shows 2 monitors SD: 4/13 and 12/5, Log SD 4/13. No visit 12/4. Use 15410242 SD:4/13 file								
22	1545-01	OFF	04/28/06	04/12/2006	04/11/2006	15450134.dat	13:56:01	2006	4

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_id
	Inv: SD 4/12 Monitor: Download date is 4/28 and time is before start time. Log SD 4/4. Data looks ok. Assuming monitor error: SD 4/28 to pick up data and look at once processded								
23	1545-01		.	04/25/2007	04/24/2007		.	.	6
24	1550-01	OFF	05/12/06	05/13/2006	05/12/2006	15500144.dat	8:00:00	2006	4
	Inv SD 5/12, given to participant 5/11, no notes Log: SD 5/13, no notes								
25	1550-01		08/05/07	08/05/2007	08/04/2007	15500123.dat	8:00:00	2007	6
26	1550-02	OFF	05/12/06	05/13/2006	05/12/2006	15500243.dat	8:00:00	2006	4
	Inv SD 5/12, given to participant 5/11, no notes Log: SD 5/13, no notes								
27	1550-02		08/05/07	08/05/2007	08/04/2007	15500299.dat	8:00:00	2007	6
28	1557-01		06/08/06	06/08/2006	06/07/2006	15570141.dat	8:00:00	2006	4
29	1557-01	OFF	09/08/07	08/02/2007	08/01/2007	15570143.dat	8:00:00	2007	6
	Inv: SD 9/8 no notes. Log: SD 9/9/07 No notes. Acc: No/little data								
30	1557-02		.	06/08/2006	06/07/2006		.	.	4
31	1557-02	OFF	09/08/07	08/02/2007	08/01/2007	15570201.dat	8:00:00	2007	6
	Inv: SD 9/8 no notes. Log: SD 9/8 No notes. Acc: Little data								
32	1557-03		06/08/06	06/08/2006	06/07/2006	15570315.dat	8:00:00	2006	4
33	1557-03	OFF	09/08/07	08/02/2007	08/01/2007	15570341.dat	8:00:00	2007	6
	Inv: SD 9/8 no notes. Log: SD 9/18/07 “Didn’t wear for football practice or Saturday” Acc: a little data at beginning 9/8, download date 9/24								

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_ id
34	1557-04		06/08/06	06/08/2006	06/07/2006	15570474.dat	8:00:00	2006	4
35	1557-04	OFF	09/08/07	08/02/2007	08/01/2007	15570447.dat	8:00:00	2007	6
	Inv: SD 9/8 no notes. Log: SD 9/8 "Didn't wear for football practice or 9/8 or 9/13" Acc: Little data								
36	1574-01	OFF	07/13/06	07/14/2006	07/13/2006	15740174.dat	8:00:00	2006	4
	Inv: SD 7/14 no notes. Probable error made on setting monitor start date. Log: SD 7/14 No notes								
37	1574-01		08/18/07	08/18/2007	08/17/2007	15740149.dat	8:00:00	2007	6
38	1576-04	OFF	07/08/06	07/07/2006	07/06/2006	15760498.dat	8:00:00	2006	4
	Inv: SD 7/8/06 no notes. Log: "Refused" Acc: Has data								
39	1576-04		02/24/08	02/24/2008	02/23/2008	15760448.dat	8:00:00	2008	6
40	1577-01	OFF	09/08/06	07/19/2006	07/18/2006	15770146.dat	8:00:00	2006	4
	Inv: SD 9/8 no notes. Log: SD 9/8 No notes								
41	1577-01		12/08/07	12/08/2007	12/07/2007	15770194.dat	8:00:00	2007	6
42	1577-02	OFF	09/08/06	07/19/2006	07/18/2006	15770247.dat	8:00:00	2006	4
	Inv: SD 9/8 no notes. Log: SD 9/8 No notes								
43	1577-02		12/13/07	12/13/2007	12/12/2007	15770247.dat	8:00:00	2007	6
44	1582-03	OFF	07/29/06	07/25/2006	07/24/2006	15820365.dat	8:00:00	2006	4
	Inv: SD 7/29 no notes. Log: SD 7/31/06 Notes: "Forgot on 8/2, sick 8/6"								
45	1582-03		03/05/08	03/05/2008	03/04/2008	15820335.dat	8:00:00	2008	6
46	1583-01	OFF	08/01/06	07/26/2006	07/25/2006	15830174.dat	8:00:00	2006	4

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_id
	Inv: SD 8/1 no notes. Log: “Refused” Acc: Has data								
47	1583-01		11/03/07	11/03/2007	11/02/2007	15830153.dat	8:00:00	2007	6
48	1583-02	OFF	08/01/06	07/26/2006	07/25/2006	15830243.dat	8:00:00	2006	4
	Inv: SD 8/1 no notes. Log: SD 8/1/06 No notes								
49	1583-02		11/03/07	11/03/2007	11/02/2007	15830241.dat	8:00:00	2007	6
50	1594-01	OFF	08/12/06	08/11/2006	08/10/2006	15940192.dat	8:00:00	2006	4
	Inv: SD 8/12 no notes. Log: SD 8/12/06 No notes								
51	1594-01		09/20/07	09/20/2007	09/19/2007	15940138.dat	8:00:00	2007	6
52	1594-02	OFF	08/12/06	08/11/2006	08/10/2006	15940240SN.dat	8:00:00	2006	4
	Inv: SD 8/12 notes SN file (Epoch problem) Log: SD 8/12 No notes								
53	1594-02		09/20/07	09/20/2007	09/19/2007	15940245.dat	8:00:00	2007	6
54	1596-01		08/13/06	08/13/2006	08/12/2006	15960135.dat	8:00:00	2006	4
55	1596-01		10/27/07	10/27/2007	10/26/2007	15960194.dat	8:00:00	2007	6
56	1596-01	OFF	11/14/07	.	.	15960148.dat	8:00:00	2007	99
	Inv: SD 11/14 note:”2nd monitor didn’t wear 1st”. Use 2nd monitor 15960148.dat.								
57	1602-01		08/25/06	08/25/2006	08/24/2006	16020143.dat	8:00:00	2006	4
58	1602-01	OFF	10/12/07	10/04/2007	10/03/2007	16020147.dat	8:00:00	2007	6
	Inv: SD 10/12 no notes. Log SD 10/2, no notes								

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_id
59	1609-01		09/19/06	09/19/2006	09/18/2006	16090192.dat	8:00:00	2006	4
60	1609-01		.	04/22/2008	04/21/2008		.	.	6
61	1609-01	OFF	09/14/06	.	.	16090101.dat	8:00:00	2006	99
	Part. Acc Inv Log Visitdate -01 9/19 & 9/14 9/19 & 9/14 9/19 9/18/06 -02 9/10 9/10 9/10 9/9 -03 "Refused" 9/13 -04 9/19 9/19 9/18 -05 9/14 9/14 "Refused" 9/13 child Think that 1. 03 and 05 didn't really refuse and 2. file 16090101.dat was in error. Rename file 16090101 to 16090301.								
62	1634-02		10/27/06	10/27/2006	10/26/2006	16340237.dat	8:00:00	2006	4
63	1634-02	OFF	01/04/08	12/22/2007	12/21/2007	16340249.dat	8:00:00	2008	6
	Inv: SD 1/4 no notes Log: SD 1/4 No notes								
64	1642-01	OFF	11/21/06	11/08/2006	11/07/2006	16420146.dat	8:00:00	2006	4
	Inv: SD 11/21 no notes Log: 11/21/06 No notes								
65	1642-01		02/08/08	02/08/2008	02/07/2008	16420142.dat	8:00:00	2008	6
66	1642-02	OFF	11/21/06	11/08/2006	11/07/2006	16420237.dat	8:00:00	2006	4
	Inv: SD 11/21 no notes Log: SD 11/21/06 No notes								
67	1642-02		02/08/08	02/08/2008	02/07/2008	16420238.dat	8:00:00	2008	6

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_ id
68	1647-01	OFF	12/02/06	12/07/2006	12/06/2006	16470143.dat	8:00:00	2006	4
	Inv: SD 12/2 no notes Log: SD 12/2/06 No notes Look at data after processed. Might be monitor error.								
69	1647-01		03/06/08	03/06/2008	03/05/2008	16470132.dat	8:00:00	2008	6
70	1675-01	OFF	06/07/07	05/20/2007	05/19/2007	16750143.dat	8:00:01	2007	4
	Inv: SD 6/7 notes “< 7 days” Log: SD 6/7/07 “Incomplete Data”								
71	1675-01		.	07/25/2008	07/24/2008		.	.	6
72	1675-02	OFF	07/12/07	05/20/2007	05/19/2007	16750294.dat	8:00:00	2007	4
	Inv: SD 7/12 no notes Log: SD 7/12/07 No notes								
73	1675-02		.	07/25/2008	07/24/2008		.	.	6
74	1684-01		.	02/17/2007	02/16/2007		.	.	4
75	1684-01	OFF	04/02/08	03/28/2008	03/27/2008	16840184SN.dat	8:00:00	2008	6
	Inv: SD 4/2 no notes Log: SD 4/2/08 No notes								
76	1684-02		.	02/17/2007	02/16/2007		.	.	4
77	1684-02	OFF	04/02/08	03/28/2008	03/27/2008	16840274.dat	8:00:00	2008	6
	Inv: SD 4/2 no notes Log: SD 4/2/08 No notes								
78	1693-01	OFF	09/12/07	06/29/2007	06/28/2007	16930199.dat	8:00:00	2007	4
	Inv: SD 9/12 note ”wore 2 days, no log sheets”								
79	1693-01		07/12/08	07/12/2008	07/11/2008	16930143.dat	8:00:00	2008	6

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_ id
80	1693-02	OFF	09/12/07	06/29/2007	06/28/2007	16930271.dat	8:00:00	2007	4
	Inv: SD 9/12 note ”wore 2 days, no log sheets”								
81	1693-02		.	07/12/2008	07/11/2008		.	.	6
82	1842-01	OFF	06/07/07	05/06/2007	05/05/2007	18420192.dat	8:00:01	2007	4
	Inv: SD 6/7 no notes Log: SD 6/7/07 “incomplete data”								
83	1842-01		.	08/24/2008	08/23/2008		.	.	6
84	1842-02	OFF	06/07/07	05/06/2007	05/05/2007	18420246.dat	8:00:01	2007	4
	Inv: SD 6/7 no notes Log: SD6/7/07 “incomplete data”								
85	1842-02		08/24/08	08/24/2008	08/23/2008	18420244.dat	8:00:00	2008	6
86	1842-03	OFF	06/07/07	05/06/2007	05/05/2007	18420336.dat	8:00:01	2007	4
	Inv: SD 6/7 no notes Log: SD6/7/07 No notes								
87	1842-03		08/24/08	08/24/2008	08/23/2008	18420346.dat	8:00:00	2008	6
88	1868-01	OFF	09/08/07	06/30/2007	06/29/2007	18680140.dat	8:00:00	2007	4
	Inv: SD 9/8 no notes Log: SD 9/8/07 “incomplete data”								
89	1868-01		06/29/08	06/29/2008	06/28/2008	18680132.dat	8:00:00	2008	6
90	1868-03	OFF	09/08/07	06/30/2007	06/29/2007	18680374.dat	8:00:00	2007	4
	Inv: SD 9/8 no notes Log: NO LOG								
91	1868-03		.	06/29/2008	06/28/2008		.	.	6

Obs	parid	Start match	startdate	prstartdate	visdate	f2r	starttime	directory	visit_ id
92	1911-03	OFF	07/11/07	06/08/2007	06/07/2007	19110353.dat	8:00:00	2007	4
	Inv: SD 7/11 notes "2nd monitor…." Can't read Log: 7/11 no notes Rose: Probably didn't wear 1st monitor – given second monitor 7/10 to complete. Allow second monitor.								
93	1911-03		.	07/04/2008	07/03/2008		.	.	6

Obs	parid	startmatch	startdate	prstartdate	visdate	f2r	starttime	directory	visit_ id
11	1039-01		11/20/05	11/20/2005	11/19/2005	10390141.dat	8:00:00	2006	4
12	1039-01	OFF	05/09/07	02/25/2007	02/24/2007	10390134.dat	15:17:49	20072	6
	Inv: There is no one with a SD of 5/9/07. Monitor given 2/25/07 notes: can't read all, "no data" crossed out. Acc: Startdate = stopdate, little data. Log: Notes: "no data reported for 3/3/07" Outcome = completed SD: 2/25/07 Look at data for review after processing								
14	1104-01		01/06/06	01/06/2006	01/05/2006	11040147.dat	8:00:00	2006	4
15	1104-01	OFF	01/25/07	01/26/2007	01/25/2007	11040137.dat	8:00:00	20072	6
	Inv: SD 1/25/07 no notes. Log: SD 1/26/07 no notes								
16	1104-02		01/06/06	01/06/2006	01/05/2006	11040201.dat	8:00:00	2006	4
17	1104-02	OFF	01/25/07	01/26/2007	01/25/2007	11040241.dat	8:00:00	20072	6
	Inv: SD 1/25/07 no notes. Log: SD 1/26/07 no notes								
20	1518-01	OFF	05/30/07	05/16/2007	05/15/2007	15180112.dat	8:00:00	20072	4
21	1518-01		.	05/13/2008	05/12/2008		.	.	6
	Inv:SD 5/30/07 no notes Log: SD 5/30/07								
22	1518-02	OFF	05/30/07	05/16/2007	05/15/2007	15180240.dat	8:00:00	20072	4
23	1518-02		.	05/13/2008	05/12/2008		.	.	6
	Inv:SD 5/30/07 no notes Log: SD 5/30/07								
24	1518-03	OFF	05/30/07	05/16/2007	05/15/2007	15180334.dat	8:00:00	20072	4
25	1518-03		.	05/13/2008	05/12/2008		.	.	6

	Inv:SD 5/30/07 no notes Log: SD 5/30/07								
30	1539-01		.	03/12/2006	03/11/2006		.	.	4
31	1539-01	OFF	04/27/07	04/22/2007	04/21/2007	15390184.dat	8:00:00	20072	6
	Inv: SD 4/27/07 no notes. Log: 4/27/07 no notes								
32	1539-02		03/12/06	03/12/2006	03/11/2006	15390247.dat	8:00:00	2006	4
33	1539-02	OFF	04/27/07	04/22/2007	04/21/2007	15390212.dat	8:00:00	20072	6
	Inv: SD 4/27/07 no notes. Log: 4/27/07 no notes								
34	1539-03		03/12/06	03/12/2006	03/11/2006	15390346.dat	8:00:00	2006	4
35	1539-03	OFF	04/27/07	04/22/2007	04/21/2007	15390394.dat	8:00:00	20072	6
	Inv: SD 4/27/07 no notes. Log: 4/27/07 no notes								
36	1540-01		03/15/06	03/15/2006	03/14/2006	15400144.dat	8:00:00	2006	4
37	1540-01	OFF	06/09/07	05/24/2007	05/23/2007	15400146.dat	8:00:00	20072	6
	Inv: SD 6/9/07 no notes Log: SD 6/9/07 no notes. family member clinic visit 6/8/07								
38	1544-01		04/19/06	04/19/2006	04/18/2006	15440143.dat	8:00:00	2006	4
39	1544-01	OFF	06/14/07	04/27/2007	04/26/2007	15440149.dat	8:00:00	20072	6
	Inv: SD 6/14/07 no notes Log: SD 6/14/07 no notes								
40	1544-02		04/19/06	04/19/2006	04/18/2006	15440232.dat	8:00:00	2006	4
41	1544-02	OFF	06/14/07	04/27/2007	04/26/2007	15440243.dat	8:00:00	20072	6
	Inv: SD 6/14/07 no notes Log: SD 6/14/07 no notes								
42	1545-01	OFF	04/28/06	04/12/2006	04/11/2006	15450134.dat	13:56:01	2006	4
43	1545-01	OFF	05/08/07	04/25/2007	04/24/2007	15450144.dat	8:00:00	20072	6

	Inv: SD 5/8/07 no notes Log: SD 5/8/07 no notes								
44	1545-02		.	04/12/2006	04/11/2006		.	.	4
45	1545-02	OFF	05/08/07	04/25/2007	04/24/2007	15450235.dat	8:00:00	20072	6
	Inv: SD 5/8/07 no notes Log: SD 5/8/07 no notes								
46	1545-03		04/12/06	04/12/2006	04/11/2006	15450337.dat	8:00:00	2006	4
47	1545-03	OFF	05/08/07	04/25/2007	04/24/2007	15450337.dat	8:00:00	20072	6
	Inv: SD 5/8/07 no notes Log: SD 5/8/07 no notes								
48	1546-01		04/20/06	04/20/2006	04/19/2006	15460136.dat	8:00:00	2006	4
49	1546-01	OFF	05/16/07	04/25/2007	04/24/2007	15460146.dat	8:00:00	20072	6
	Inv: SD 5/16/07 no notes Log: SD 5/16/07 no notes								
50	1546-02		04/20/06	04/20/2006	04/19/2006	15460248.dat	8:00:00	2006	4
51	1546-02	OFF	05/16/07	04/25/2007	04/24/2007	15460284.dat	8:00:00	20072	6
	Inv: SD 5/16/07 no notes Log: SD 5/16/07 no notes								
86	1625-01	OFF	01/09/07	10/18/2006	10/17/2006	16250194SN.dat	8:00:00	20072	4
	Inv: SD 10/18/06 notes: “no data”, SD 1/9/07 note: “SN” Log: SD 10/18/06 note: “Data didn’t download for Oct. Second baseline is week of 1/22/07-1/29/07” This date doesn’t match monitor or INV.								
87	1625-01		02/29/08	02/29/2008	02/28/2008	16250138.dat	8:00:00	2008	6
88	1625-02	OFF	01/09/07	10/18/2006	10/17/2006	16250216SN.dat	8:00:00	20072	4
	Inv: SD 10/18/06 notes: “no data”, SD 1/9/07 note: “SN” Log: SD 1/22/07 no note. Look processed data								
89	1625-02		02/29/08	02/29/2008	02/28/2008	16250247.dat	8:00:00	2008	6
102	1676-01	OFF	06/08/07	06/06/2007	06/05/2007	16760184.dat	8:00:00	20072	4

	Inv: SD 6/8/07 no notes Log: SD 6/8/07 no notes								
103	1676-02	OFF	06/08/07	06/06/2007	06/05/2007	16760233.dat	8:00:00	20072	4
	Inv: SD 6/8/07 no notes Log: SD 6/8/07 no notes								
104	1684-01		02/17/07	02/17/2007	02/16/2007	16840142.dat	8:00:00	20072	4
105	1684-01	OFF	04/02/08	03/28/2008	03/27/2008	16840184SN.dat	8:00:00	2008	6
	Inv: SD 4/2/08 no notes Log: SD 4/2/08 no notes								
106	1684-02		02/17/07	02/17/2007	02/16/2007	16840249.dat	8:00:00	20072	4
107	1684-02	OFF	04/02/08	03/28/2008	03/27/2008	16840274.dat	8:00:00	2008	6
	Inv: SD 4/2/08 no notes Log: SD 4/2/08 no notes								
112	1703-02	OFF	05/09/07	03/08/2007	03/07/2007	17030243.dat	15:14:42	20072	4
	Inv: SD 3/8/07 Log: SD 3/8/07 no notes Acc: SD = download date Review data once processed								
113	1703-02		03/27/08	03/27/2008	03/26/2008	17030299.dat	8:00:00	2008	6
114	1711-01	OFF	04/28/07	04/26/2007	04/25/2007	17110142.dat	8:00:00	20072	4
	Inv: SD 4/28/07 Log: SD 4/28/07 no notes								
115	1711-01		05/07/08	05/07/2008	05/06/2008	17110140.dat	8:00:00	2008	6
116	1711-03	OFF	04/28/07	04/26/2007	04/25/2007	17110336.dat	8:00:00	20072	4
	Inv: SD 4/28/07 Log: SD 4/28/07 no notes								
117	1711-03		07/18/08	07/18/2008	07/17/2008	17110327.dat	8:00:00	2008	6
118	1711-04	OFF	04/28/07	04/26/2007	04/25/2007	17110440SN.dat	8:00:00	20072	4
	Inv: SD 4/28/07 Log: SD 4/28/07 no notes								
119	1711-04		05/07/08	05/07/2008	05/06/2008	17110433.dat	8:00:00	2008	6

120	1711-05	OFF	04/28/07	04/26/2007	04/25/2007	17110547.dat	8:00:00	20072	4
	Inv: SD 4/28/07 Log: SD 4/28/07 no notes								
121	1711-05		05/07/08	05/07/2008	05/06/2008	17110574.dat	8:00:00	2008	6
122	1717-01	OFF	05/30/07	05/13/2007	05/12/2007	17170142.dat	8:00:00	20072	4
	Inv: SD 5/30/07 no notes Log: SD 5/30/07 no notes								
123	1717-01		05/28/08	05/28/2008	05/27/2008	17170148.dat	8:00:00	2008	6
124	1717-02	OFF	05/30/07	05/13/2007	05/12/2007	17170216.dat	8:00:00	20072	4
	Inv: SD 5/30/07 no notes Log: SD 5/30/07 no notes								
125	1717-02		05/28/08	05/28/2008	05/27/2008	17170245.dat	8:00:00	2008	6
126	1717-03	OFF	05/30/07	05/15/2007	05/14/2007	17170343.dat	8:00:00	20072	4
	Inv: SD 5/30/07 no notes Log: SD 5/30/07 no notes								
127	1717-03		05/28/08	05/28/2008	05/27/2008	17170338.dat	8:00:00	2008	6
128	1718-01	OFF	04/28/07	04/22/2007	04/21/2007	17180123.dat	8:00:00	20072	4
	Inv: SD 4/28/07 no notes Log: SD 4/28/07 no notes								
129	1718-01		.	06/04/2008	06/03/2008		.	.	6
130	1718-02	OFF	04/28/07	04/22/2007	04/21/2007	17180249.dat	8:00:00	20072	4
	Inv: SD 4/28/07 no notes Log: SD 4/28/07 no notes								
131	1718-02		05/30/08	05/30/2008	05/29/2008	17180247.dat	8:00:00	2008	6
132	1718-03	OFF	04/28/07	04/22/2007	04/21/2007	17180332.dat	8:00:00	20072	4
	Inv: SD 4/28/07 no notes Log: SD 4/28/07 no notes								
133	1718-03		05/30/08	05/30/2008	05/29/2008	17180367.dat	8:00:00	2008	6

134	1718-04	OFF	04/28/07	04/22/2007	04/21/2007	17180445.dat	8:00:00	20072	4
	Inv: SD 4/28/07 no notes Log: SD 4/28/07 no notes								
135	1718-04		.	05/30/2008	05/29/2008		.	.	6
136	1758-01	OFF	06/14/07	05/20/2007	05/19/2007	17580141.dat	8:00:00	20072	4
	Inv: SD 6/14/07 no notes Log: no log								
137	1758-01		06/20/08	06/20/2008	06/19/2008	17580112.dat	8:00:00	2008	6
138	1758-02	OFF	06/14/07	05/20/2007	05/19/2007	17580216.dat	8:00:00	20072	4
	Inv: SD 6/14/07 no notes Log: no log								
139	1758-02		08/02/08	08/02/2008	08/01/2008	17580227.dat	8:00:00	2008	6
140	1761-02	OFF	05/09/07	03/23/2007	03/22/2007	17610233.dat	15:20:08	20072	4
	Inv: 3/23/07 Log: SD 3/23/07 Start date = download date Review data once process								
141	1761-02		04/11/08	04/11/2008	04/10/2008	17610299.dat	8:00:00	2008	6
142	1837-01	OFF	05/04/07	04/26/2007	04/25/2007	18370153.dat	8:00:00	20072	4
	Inv: SD 5/4/07 no notes Log: SD 5/4/07 no notes								
143	1837-01		05/08/08	05/08/2008	05/07/2008	18370138.dat	8:00:00	2008	6
144	1837-02	OFF	05/04/07	04/26/2007	04/25/2007	18370241.dat	8:00:00	20072	4
	Inv: SD 5/4/07 no notes Log: SD 5/4/07 no notes								
145	1837-02		05/08/08	05/08/2008	05/07/2008	18370247.dat	8:00:00	2008	6
146	1839-01	OFF	04/27/07	04/21/2007	04/20/2007	18390141SN.dat	8:00:00	20072	4
	Inv: SD 4/27/07 no notes Log: SD 4/27/07 no notes								
147	1839-01		05/07/08	05/07/2008	05/06/2008	18390141.dat	8:00:00	2008	6

148	1839-02	OFF	04/29/07	04/21/2007	04/20/2007	18390292.dat	8:00:00	20072	4
	Inv: SD 4/29/07 no notes Log: 4/29/07 no notes								
149	1839-02		05/07/08	05/07/2008	05/06/2008	18390253.dat	8:00:00	2008	6
150	1840-01	OFF	05/12/07	04/27/2007	04/26/2007	18400142.dat	8:00:00	20072	4
	Inv: SD 5/12/07 no notes Log: SD 5/12/07 no notes								
151	1840-01		06/25/08	06/25/2008	06/24/2008	18400149.dat	8:00:00	2008	6
152	1840-03	OFF	05/12/07	04/27/2007	04/26/2007	18400347.dat	8:00:00	20072	4
	Inv: SD 5/12/07 no notes Log: no log								
153	1840-03		06/25/08	06/25/2008	06/24/2008	18400343.dat	8:00:00	2008	6
154	1840-06	OFF	05/12/07	04/27/2007	04/26/2007	18400694.dat	8:00:00	20072	4
	Inv: SD 5/12/07 no notes Log: SD 5/11/07 no notes								
155	1840-06		06/25/08	06/25/2008	06/24/2008	18400646.dat	8:00:01	2008	6
162	1853-01	OFF	05/26/07	05/12/2007	05/11/2007	18530198SN.dat	8:00:00	20072	4
	Inv: SD 5/26/07 no notes Log: SD 5/26/07 no notes								
163	1853-01		05/22/08	05/22/2008	05/21/2008	18530199.dat	8:00:00	2008	6
164	1853-02	OFF	05/26/07	05/12/2007	05/11/2007	18530243.dat	8:00:00	20072	4
	Inv: SD 5/26/07 no notes Log: SD 5/26/07 no notes								
165	1853-02		05/22/08	05/22/2008	05/21/2008	18530223.dat	8:00:00	2008	6
166	1855-01	OFF	05/31/07	05/13/2007	05/12/2007	18550192.dat	8:00:00	20072	4
	Inv: SD 5/31/07 no notes Log: SD 5/31/07 “incomplete data”								
167	1855-01		08/07/08	08/07/2008	08/06/2008	18550101.dat	8:00:00	2008	6

168	1855-03	OFF	05/31/07	05/13/2007	05/12/2007	18550345.dat	8:00:00	20072	4
	Inv: SD 5/31/07 no notes Log: SD 5/31/07 "incomplete data"								
169	1855-03		08/07/08	08/07/2008	08/06/2008	18550333.dat	8:00:00	2008	6
174	1875-02	OFF	06/26/07	05/02/2007	05/01/2007	18750227.dat	15:45:01	20072	4
	Inv: SD 5/18/07 Can't read notes Log: SD 5/18/07 no notes. Start date = download date. Review data after processed.								
175	1875-02		06/27/08	06/27/2008	06/26/2008	18750292.dat	8:00:01	2008	6
176	1877-01	OFF	05/23/07	05/09/2007	05/08/2007	18770149.dat	8:00:00	20072	4
	Inv: SD 5/23/07 no notes Log: SD 5/23/07 no notes.								
177	1877-01		07/31/08	07/31/2008	07/30/2008	18770146.dat	8:00:00	2008	6
178	1877-02	OFF	05/23/07	05/09/2007	05/08/2007	18770235.dat	8:00:00	20072	4
	Inv: SD 5/23/07 no notes Log: SD 5/23/07 no notes.								
179	1877-02		07/31/08	07/31/2008	07/30/2008	18770244.dat	8:00:00	2008	6
180	1882-01	OFF	05/30/07	05/18/2007	05/17/2007	18820194.dat	8:00:00	20072	4
	Inv: SD 5/30/07 no notes Log: SD 5/20/07 no notes								
181	1882-01		.	05/28/2008	05/27/2008		.	.	6
182	1882-02	OFF	05/30/07	05/19/2007	05/18/2007	18820247.dat	8:00:00	20072	4
	Inv: SD 5/30/07 no notes Log: SD 5/20/07 no notes								
183	1882-02		.	05/28/2008	05/27/2008		.	.	6
184	1910-01	OFF	06/01/07	05/23/2007	05/22/2007	19100141.dat	8:00:00	20072	4
	Inv: SD 6/1/07 no notes Log: SD 6/1/07 no notes								

185	1910-01		.	06/03/2008	06/02/2008		.	.	6
186	1910-02	OFF	06/01/07	05/23/2007	05/22/2007	19100253.dat	8:00:00	20072	4
	Inv: SD 6/1/07 no notes Log: SD 6/1/07 no notes								
187	1910-02		06/03/08	06/03/2008	06/02/2008	19100244.dat	8:00:00	2008	6